SAE International™ SURFACE VEHICLE STANDARD

SAE J514 REV. SEP2004

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Hydraulic Tube Fittings

1. ***Scope.*** This SAE Standard covers complete general and dimensional specifications for 37 degree flared and flareless types of hydraulic tube fittings and O-ring plugs. Also included are pipe fittings and adapter unions for use in conjunction with these tube fittings. These fittings are intended for general application in hydraulic systems on industrial equipment and commercial products.

   These fittings are capable of providing leakproof, full flow connections in hydraulic systems operating at working pressures as specified in Table 1 for respective sections.

   Since many factors influence the pressure at which a hydraulic system will or will not perform satisfactorily, the values shown in SAE J1065 should not be construed as a guaranteed minimum.

   For any application, it is recommended that sufficient testing be conducted and reviewed by both the user and fitting manufacturer to assure that performance levels will be safe and satisfactory.

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TABLE 1—WORKING PRESSURE RATINGS[(d)] CAPABLE OF 4 TO 1 MINIMUM BURST

Nom SAE Dash Size	Nom Tube OD mm	Nom Tube OD in	Straight Thread Size	Nom Pipe Size	Rigid[(a)] SAE St. Threads Unions and Bulkheads MPa	Rigid[(a)] SAE St. Threads Unions and Bulkheads psi	Adjustable[(b)] SAE St. Threads and Female Swivels MPa	Adjustable[(b)] SAE St. Threads and Female Swivels psi	Fittings[(c)] With Pipe Threads MPa	Fittings[(c)] With Pipe Threads psi
2	3.18	0.125	5/16-24	1/8	34.5	5000	34.5	5000	34.5	5000
3	4.76	0.188	3/8 -24	1/8	34.5	5000	34.5	5000	34.5	5000
4	6.35	0.250	7/16-20	1/8	34.5	5000	31	4500	34.5	5000
5	7.94	0.313	1/2 -20	1/8	34.5	5000	27.5	4000	34.5	5000
6	9.52	0.375	9/16-18	1/4	34.5	5000	27.5	4000	27.5	4000
8	12.70	0.500	3/4 -16	3/8	31	4500	27.5	4000	21	3000
10	15.88	0.625	7/8 -14	1/2	24	3500	21	3000	21	3000
12	19.05	0.750	1-1/16-12	3/4	24	3500	21	3000	17	2500
14	22.22	0.875	1-3/16-12	3/4	21	3000	17	2500	17	2500
16	25.40	1.000	1-5/16-12	1	21	3000	17	2500	14	2000
20	31.75	1.250	1-5/8 -12	1-1/4	17	2500	14	2000	8	1150
24	38.10	1.500	1-7/8 -12	1-1/2	14	2000	10.5	1500	7	1000
32	50.80	2.000	2-1/2 -12	2	10.5	1500	8	1125	7	1000

(a) For fittings in Sections 1, 2, and 3.
(b) For fittings in Sections 1 and 2.
(c) For fittings in Sections 1, 2, and 4.
(d) Working pressures given are for low carbon steel fittings only. Consult the manufacturer for values for other materials.

The standard is divided into six sections as follows:

Section 1—37 Degree Flare Tube Fittings
Section 2—Flareless Tube Fittings
Section 3—O-ring Plugs (for O-ring Ports see SAE J1926)
Section 4—Hydraulic Pipe Fittings (formerly SAE J926)
Section 5—Adapter Unions (formerly in SAE J516)
Section 6—Tables for Calculating Dimensions on Special Sizes

2. References

2.1 Applicable Publications. The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS. Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J343—Tests and Procedures for SAE 100R Series Hydraulic Hose and Hose Assemblies
SAE J405—Chemical Compositions of SAE Wrought Stainless Steels
SAE J476—Dryseal Pipe Threads
SAE J533—Flares for Tubing
SAE J1065—Pressure Ratings for Hydraulic Tubing and Fittings

2.1.2 ANSI PUBLICATION. Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI B1.20.1—American Standard Straight Pipe Thread for Mechanical Joints
ANSI B1.20.3—Dryseal Pipe Threads (Inch)

2.1.3 ASTM PUBLICATION. Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117—Method of Salt Spray (Fog) Testing

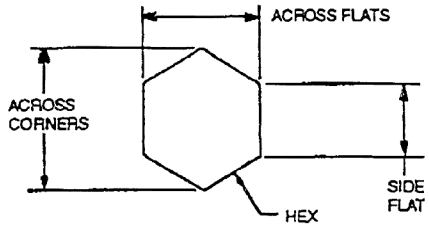
3. ***General Specifications.*** The following general specifications supplement the dimensional data contained in Tables 3 to 21 with respect to all unspecified detail.

3.1 Size Designations. Fitting sizes are designated by the corresponding outside diameter of the tubing for the various types of tube ends and by the corresponding standard nominal pipe size for pipe thread ends.

See SAE J846 for proper coding and call-out.

3.2 Dimensions and Tolerances. Except for nominal sizes and thread specifications, dimensions and tolerances are given in both SI Units and U.S. Customary as designated. Tabulated dimensions shall apply to the finished parts, plated or otherwise processed, as specified by the purchasers. Hex tolerances across flats are listed in Table 1A. The minimum across-corners dimensions of hexagons shall be 1.092 times the nominal width across flats, but shall not result in a side-flat width less than 0.43 times the nominal width across flats. The minimum across-corners dimensions of external squares shall be 1.25 times the nominal width across flats, but shall not result in a side-flat width less than 0.75 times the nominal width across the flats.

TABLE 1A—HEX TOLERANCES



Nominal Hex Size Across Flats mm Over	Nominal Hex Size Across Flats mm Include	Nominal Hex Size Across Flats in Over	Nominal Hex Size Across Flats in Include	Tolerance (Minus Only) mm	Tolerance (Minus Only) in
—	19.05	—	0.750	0.3	0.012
19.05	25.40	0.750	1.000	0.4	0.016
25.40	34.92	1.000	1.375	0.5	0.020
34.92	AND UP	1.375	AND UP	0.8	0.031

Tolerance on all dimensions not otherwise limited shall be ±0.4 mm (±0.016 in). Fitting seats shall be concentric with straight thread pitch diameters within 0.25 mm (0.010 in) full indicator movement (FIM).

Unless otherwise specified, tolerance on hole diameters designated drill in the dimensional tables shall be as tabulated in Table 1B:

TABLE 1B—DRILL TOLERANCES

Drill Size Range mm	Drill Size Range in	Tolerance, mm Plus	Tolerance, mm Minus	Tolerance, in Plus	Tolerance, in Minus
0.00 – 6.00	0.000 – 0.236	0.1	0.1	0.004	0.004
over 6.00 – 25.0	0.237 – 0.984	0.2	0.2	0.008	0.008
over 25.0	over 0.984	0.3	0.3	0.012	0.012

Angular tolerance on axis of ends on elbows, tees, and crosses shall be ±2.50 degrees for 1/8 to 3/8 in tube fittings or 1/8 and 1/4 pipe fittings; ±1.50 degrees for 1/2 to 2 in O.D. tube fittings or 3/8 to 2 in pipe fittings.

Where so illustrated and not otherwise specified, hexagon corners shall be chamfered 15 to 30 degrees to a diameter equal to the width across flats, with a minus tolerance of 0.4 mm (0.016 in); or where design permits, corners may be chamfered to the diameter of the abutting surface providing the length of chamfer does not exceed that produced by the 30 degree chamfer previously described.

Alternatively, on connections other than SAE straight thread, a 5 degree chamfer starting at the undercut diameter behind the threads or outside diameter of the threads shall be allowed, providing the hex width at corners is not reduced below that produced by the 30 degree chamfer previously described.

3.3 Passages. Where passages in straight fittings are machined from opposite ends, the offset at the meeting point shall not exceed 0.4 mm (0.016 in). The cross-sectional area at the junction of passages in angle fittings shall not be less than that of the smallest passage.

3.4 Wall Thickness. Unless otherwise designated, the wall thickness at any point on fittings shall not be less than the thickness established by the specified dimensions, tolerances, and eccentricities for inner and outer surfaces.

3.5 Contour. Details of contour shall be optional with manufacturer provided the tabulated dimensions are maintained and serviceability of the fittings is not impaired.

3.6 Straight Threads. Unified Standard Class 2A external and Class 2B internal threads with modified minor diameters, where specified, shall apply to plain finish (unplated) fittings of all types. For externally threaded parts with additive finish, the maximum diameters of Class 2A may be exceeded by the amount of the allowance, that is, the basic diameters (Class 2A maximum diameters plus the allowance) apply to an externally threaded part after plating. For internally threaded parts with additive finish, the Class 2B diameters and modified minor diameters apply after plating.

The pitch diameter tolerance shall be the same as the corresponding diameter-pitch combination and class of the Unified fine and 12 thread series. See SAE J475 (ISO R725).

Where external threads are produced by roll threading and body is not undercut, the unthreaded portion of body adjacent to the shoulder may be reduced to the minimum pitch diameter.

External threads shall be chamfered and internal threads shall be countersunk as specified in the dimensional tables.

3.7 Thread Eccentricity Tolerances. The various thread elements of Class 2A external and Class 2B, modified, internal threads on tube fittings shall be concentric within the following limitations:

3.7.1 EXTERNAL THREAD (SCREW)

a. Where screw pitch diameter is maximum and screw major diameter is maximum, these two thread elements must be concentric. However, if the screw major diameter is out-of-round, undersize, these two thread elements may be eccentric at the point of out-of-roundness, a full indicator reading amount equal to the screw major diameter tolerance.
b. Where screw pitch diameter is minimum and screw major diameter is maximum, these two thread elements may be eccentric a full indicator reading amount equal to the screw pitch diameter tolerance.
c. Where screw pitch diameter is maximum and screw major diameter is minimum, these two thread elements may be eccentric a full indicator reading amount equal to the screw major diameter tolerance.
d. Where screw pitch diameter is minimum and screw major diameter is minimum, these two thread elements may be eccentric a full indicator reading amount equal to the sum of the screw pitch diameter tolerance and the screw major diameter tolerance.

3.7.2 INTERNAL THREAD (NUT)

a. Where nut pitch diameter is minimum and nut minor diameter is minimum, these two thread elements must be concentric. However, if the nut minor diameter is out-of-round, oversize, the two thread elements may be eccentric at the point of out-of-roundness, a full indicator reading amount equal to the nut minor diameter tolerance.
b. Where nut pitch diameter is maximum and nut minor diameter is minimum, these two thread elements may be eccentric a full indicator reading amount equal to the nut pitch diameter tolerance.

c. Where nut pitch diameter is minimum and nut minor diameter is maximum, these two thread elements may be eccentric a full indicator reading amount equal to the nut minor diameter tolerance.
d. Where nut pitch diameter is maximum and nut minor diameter is maximum, these two thread elements may be eccentric a full indicator reading amount equal to the sum of the nut pitch diameter tolerance and the nut minor diameter tolerance.

3.8 Pipe Threads. Pipe threads, unless there is specific authorization to the contrary, shall conform to the Dryseal American Standard Taper Pipe Thread (NPTF). Specifications are given in detail in SAE J476 (ANSI B1.20.3).

The length of full form external thread shall not be shorter than L_2 plus one pitch (thread).

Where external pipe threads are produced by roll threading, the diameter of the unthreaded shank adjacent to shoulder may be reduced to the E_2 pitch diameter for brass fittings and to the root diameter on steel fittings.

External pipe threads shall be chamfered from the diameters tabulated below to produce the specified length of chamfer or partial thread. Internal pipe threads shall be countersunk 90 degrees, included angle, to the diameters tabulated in Table 2:

TABLE 2—PIPE THREAD CHAMFER DIAMETERS

Nominal Pipe Thread Size	External Thread Chamfer Dia Max mm	External Thread Chamfer Dia Max in	External Thread Chamfer Dia Min mm	External Thread Chamfer Dia Min in	External Thread Length of Chamfer or Partial Thread Min mm	External Thread Length of Chamfer or Partial Thread Min in	External Thread Length of Chamfer or Partial Thread Max mm	External Thread Length of Chamfer or Partial Thread Max in	Internal Thread Counter-sink Dia Min mm	Internal Thread Counter-sink Dia Min in	Internal Thread Counter-sink Dia Max mm	Internal Thread Counter-sink Dia Max in
1/8	8.1	0.32	7.6	0.30	0.94	0.037	1.40	0.055	10.7	0.42	11.2	0.44
1/4	10.7	0.42	10.2	0.40	1.42	0.056	2.13	0.084	14.0	0.55	14.5	0.57
3/8	14.0	0.55	13.5	0.53	1.42	0.056	2.13	0.084	17.5	0.69	18.0	0.71
1/2	17.3	0.68	16.8	0.66	1.80	0.071	2.72	0.107	21.6	0.85	22.1	0.87
3/4	22.6	0.89	22.1	0.87	1.80	0.071	2.72	0.107	26.9	1.06	27.4	1.08
1	28.4	1.12	27.7	1.09	2.21	0.087	3.30	0.130	34.0	1.34	34.8	1.37
1-1/4	37.1	1.46	36.3	1.43	2.21	0.087	3.30	0.130	42.7	1.68	43.4	1.71
1-1/2	43.2	1.70	42.4	1.67	2.21	0.087	3.30	0.130	48.8	1.92	49.5	1.95
2	55.1	2.17	54.4	2.14	2.21	0.087	3.30	0.130	60.7	2.39	61.5	2.42

Tabulated diameters conform with Appendix A of SAE J476.

3.9 Material. Unless otherwise specified, fittings and ferrules shall be made from carbon steel. Flareless type ferrules in Figures 28 and 29 shall be made from SAE 1010, 1112, 1113, 1213, 12L14, or 1215 steel and cyanide hardened to a depth of 0.03 to 0.05 mm (0.0010 to 0.0019 in).

Stainless steel fittings shall be made from AISI Type 300 Series stainless steel of good quality.[1] Flareless type ferrules in Figures 28 and 29 shall be made from stainless steel of such hardness as to be capable of biting, fully annealed type 304 stainless steel tubing. Unless otherwise specified by the purchaser, stainless steel fittings shall be passivated. Carbon steel and stainless steel fittings fabricated from multiple components must be bonded together with materials having a melting point of not less than 996 °C (1825 °F).

Thirty-seven degree flared type and pipe type brass fittings shall be made from C36000 (CA360) one-half hard barstock or extruded shapes or C37700 (CA377) forgings.

1. See SAE J405.

3.10 Finish. The external surfaces and threads of all carbon steel parts shall be plated or coated with a suitable material that passes a 72 h salt spray test in accordance with ASTM B 117. Any appearance of red rust during the 72 h salt spray test shall be considered failure, except for the following:

a. All internal fluid passages.
b. Edges such as hex points, serrations, and crests of threads where there may be mechanical deformation of the plating or coating typical of mass-produced parts or shipping effects.
c. Areas where there is mechanical deformation of the plating or coating caused by crimping, flaring, bending, and other post-plate metal forming operations.
d. Areas where the parts are suspended or affixed in the test chamber where condensate can accumulate.

NOTE— Cadmium plating is not preferred due to environmental reasons. Parts manufactured to this document after January 1, 1997, shall not be cadmium plated. Internal fluid passages shall be protected from corrosion during storage. Changes in plating may affect assembly torques and require requalification, when applicable.

3.11 Workmanship. Workmanship shall conform to the best commercial practice to produce high-quality fittings. Fittings shall be free from all hanging burrs, loose scale, and slivers which might become dislodged in usage and all other defects which might affect their serviceability. All sealing surfaces must be smooth except that annular tool marks up to 2.5 µm (100 µin) max A.A. shall be permissible.

3.12 Assembly Considerations. Use of a compatible lubricant is desirable in assembling dryseal pipe threads on hydraulic tube or pipe fittings to minimize galling and effect a pressure-tight seal.

The O-ring washer must be clinched to fitting with a tight slip fit to an interference fit. The slip fit shall be tight enough so that washer cannot be shaken loose to cause it to drop from its uppermost position by its own weight. The interference fit shall not require a locknut torque more than that indicated in Table 3 of SAE J1453. Position the washer farthest from the end of the fittings as shown in Figure 10A. Care must be taken not to clinch washer on the transition area between diameter Y and locknut thread which results in a loose washer when it is repositioned at assembly. Washer flatness allowance is given in Table 3 of SAE J1453. Any surface out of flatness must be uniform (not wavy) and concave with respect to the O-ring boss end of the fitting.

Torque values listed in Table 2A are for controlled testing to establish compliance to the performance requirements set forth in Table 1. Recommended assembly torques by manufacturers may vary from Table 2A.

Smaller sizes (–2 through –8) of 37 degree flare fittings are less tolerant to over torquing than the larger sizes. Over torquing in these sizes causes deformation of 37 degree cone of the male end. Excessive deformation of the cone results in loss of clamping force and, hence, loss of seal. It also reduces flow area.

Plating combination, surface finish, lubrication, etc., influence fittings' propensity for deformation when assembled to a given torque value. For this reason, many manufacturers recommend assembly to a given number of turns or flats of nut from finger tight position. This method circumvents the influence of variables listed previously, eliminating possibility of excess deformation of 37 degree cone. It is recommended that this method be followed wherever possible.

4. Performance Requirements. See Appendix B for minimum number of samples required for testing.

4.1 Working Pressure (For All Sections). Working pressures for fittings shall be as listed in Table 1 or as specified in respective section. Proof pressures shall be twice the working pressures, and minimum burst pressures shall be four times the working pressures.

4.2 Proof Test (For All Sections). All fittings for tubing and adapters shall be capable of withstanding proof pressure for a period of 1 min without failure or leakage.

4.3 Burst Test (For All Sections). Burst test shall be conducted at minimum torque values or minimum number of turns from finger tight position specified in assembly procedure by manufacturer. For testing only, all adapter to hose fittings or tube fitting threads and contact surfaces shall be lubricated with SAE 10W hydraulic oil prior to assembly. Test blocks for burst testing shall be hardened to 45 to 55 HRC and left unplated. Adjustable fittings shall be backed out one full turn from finger tight position. The test shall be conducted as specified in SAE J343.

4.4 Cyclic Endurance (Impulse) Test (For All Sections). All tube fittings and adapters shall pass a cyclic endurance test for one million cycles at 133% of corresponding working pressures as established per 4.1. The cycle test shall be conducted at minimum torque or number of turns from finger tight assembly. For testing only, all threads and contact surfaces shall be lubricated with SAE 10W hydraulic oil prior to assembly. Cycle rate shall be uniform at –5 to 1.3 Hz and shall conform in magnitude and frequency to the wave pattern shown in Figure 1 of SAE J343.

4.5 Hose Coupling Interface. Along with over torque test per 4.7, adapter interface and nut portion of hose stem assemblies shall meet proof, burst, and cyclic endurance requirements of hose to which they are attached.

4.6 O-ring. The standard O-ring used on SAE straight thread end for testing shall be nitrile (NBR) rubber with a durometer “A” hardness of 90.

4.7 Over Torque Test (For Fittings in Section 1). Fitting swivel nuts shall be capable of withstanding the overtorque qualification test with no indication of failure. For testing only, all threads and contact surfaces shall be lubricated with SAE 10W hydraulic oil prior to applying torque listed in respective sections. Test adapters for torque testing shall be hardened to 40 to 50 HRC and left unplated. The fitting shall be restrained during test and the wrench shall be located at the threaded end of the nut hex. Nuts that go through brazing in production shall be put through similar annealing cycle before testing.

Definition of failure after torque testing:

a. Nut cannot be removed by hand after breakaway.
b. Nut cannot swivel freely by hand.
c. Any visible cracks or severe deformation that would render nut unuseable.

4.8 Repeated Assembly (For Fittings in Section 1). Three samples each of male flare shaped fittings assembled to tube flare (with sleeve and nut) and female swivel end shall be tested. Samples shall be assembled and disassembled ten times. Fittings shall be tightened, with threads lubricated with 10W hydraulic oil, to maximum torque values shown in Table 2A. Proof test per 4.2 shall be conducted following the first, fifth, and tenth assembly. There shall be no leakage and the fitting nut shall remain free to swivel by hand after the tenth disassembly.

TABLE 2A—QUALIFICATION TEST TORQUE[b] REQUIREMENTS

Nom SAE Dash Size	Nom Tube OD mm	Nom Tube OD in	Tube End and SAE O-Ring Port Thr'd Size	37 degree Flare End Swivel Nut Torque Nm	37 degree Flare End Swivel Nut Torque lb-ft	37 degree Flare End Swivel Nut Over Torque Nm	37 degree Flare End Swivel Nut Over Torque lb-ft	SAE O-Ring[a] Port End Torque Nm	SAE O-Ring[a] Port End Torque lb-ft
2	3.18	0.125	5/16-24	8- 9	6- 7	15	11	8- 9	6- 7
3	4.76	0.188	3/8 -24	11- 12	8- 9	19	14	11- 12	8- 9
4	6.35	0.250	7/16-20	15- 16	11- 12	24	18	18- 20	13- 15
5	7.94	0.313	1/2 -20	19- 21	14- 15	31	23	23- 26	17- 19
6	9.52	0.375	9/16-18	24- 28	18- 20	42	31	29- 33	22- 24
8	12.70	0.500	3/4 -16	49- 53	36- 39	80	59	49- 53	40- 43
10	15.88	0.625	7/8 -14	77- 85	57- 63	114	85	59- 64	43- 48
12	19.05	0.750	1-1/16-12	107-119	79- 88	160	118	93-102	68- 75
14	22.22	0.875	1-3/16-12	127-140	94-103	186	138	122-134	90- 99
16	25.40	1.000	1-5/16-12	147-154	108-113	214	158	151-166	112-123
20	31.75	1.250	1-5/8 -12	172-181	127-133	271	200	198-218	146-161
24	38.10	1.500	1-7/8 -12	215-226	158-167	339	250	209-231	154-170
32	50.80	2.000	2-1/2 -12	332-350	245-258	497	368	296-325	218-240

[a] This torque is applicable to fittings in Sections 1, 2, 3, and 5.

[b] Test torques given here are for low carbon steel fittings only. Consult the manufacturer for values for other materials.

5. ***Section 1—37 Degree Flare Tube Fittings.*** The 37 degree flared tube fittings shall be as shown in Figures 1 to 15 and Tables 3 to 7. Since the basic design of these fittings is derived from Air Force and Navy Standards for 37 degree flared fittings which meet a performance specification, any future changes should not be detrimental to the design or performance. Dimensions for double and single 37 degree flares on tubing to be used with these fittings are given in Figure 3 and Table 2 of SAE J533.

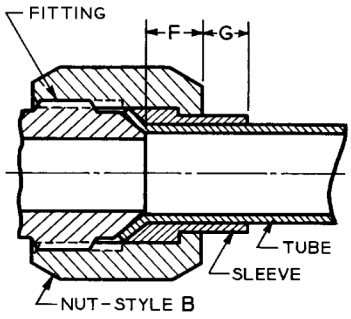


FIGURE 1A—THREE PIECE TUBE ASSEMBLY

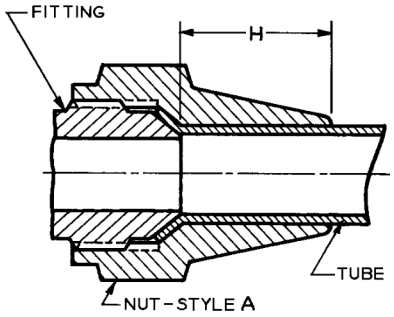


FIGURE 1B—TWO PIECE TUBE ASSEMBLY

FIGURE 1—DETAILS OF 37 DEGREE FLARED HYDRAULIC TUBE FITTING ASSEMBLIES (FIGURE 1)

TABLE 3—DIMENSIONS OF 37 DEGREE FLARED HYDRAULIC TUBE FITTING ASSEMBLIES (FIGURE 1)

Nominal Tube OD	F (Ref) mm	F (Ref) in	G (Ref) mm	G (Ref) in)	H (Ref) mm	H (Ref) in
1-1/8	4.8	0.19	3.0	0.12	12.2	0.48
3/16	6.4	0.25	3.0	0.12	14.2	0.56
1/4	4.8	0.19	4.3	0.17	15.0	0.59
5/16	7.6	0.30	2.8	0.11	16.8	0.66
3/8	7.1	0.28	4.8	0.19	17.5	0.69
1/2	7.9	0.31	4.8	0.19	20.6	0.81
5/8	9.7	0.38	6.9	0.27	23.9	0.94
3/4	9.1	0.36	6.4	0.25	26.2	1.03
7/8	9.7	0.38	7.9	0.31	30.2	1.19
1	8.6	0.34	10.4	0.41	33.3	1.31
1-1/4	8.6	0.34	9.9	0.39	38.1	1.50
1-1/2	12.7	0.50	14.0	0.55	38.9	1.53
2	14.0	0.55	13.5	0.53	44.4	1.75

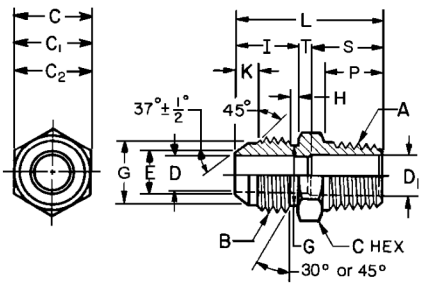


FIGURE 2A—MALE CONNECTOR (070102)

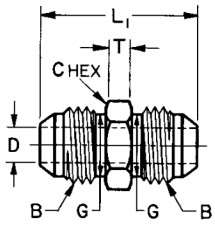


FIGURE 2B—UNION (070101)

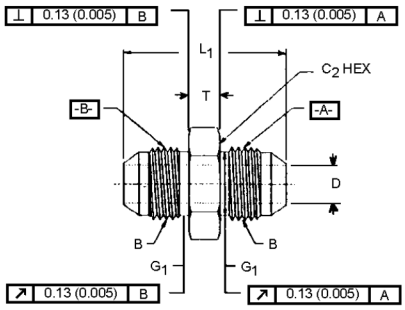


FIGURE 2C—LARGE HEX UNION* (070119)

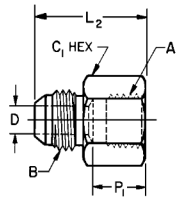


FIGURE 2D—
FEMALE CONNECTOR
(070103)

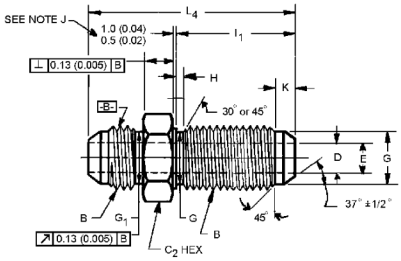


FIGURE 3A—BULKHEAD UNION
(070601) SEE NOTE J

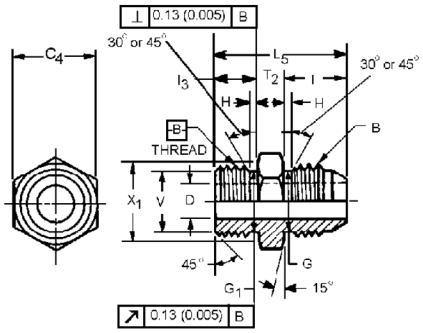


FIGURE 3B—STRAIGHT THREAD
CONNECTOR SHORT* (070120)

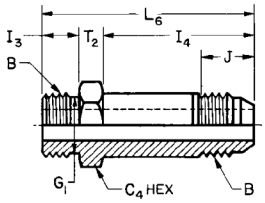


FIGURE 3C—
STRAIGHT
THREAD
CONNECTOR
LONG*
(071720)

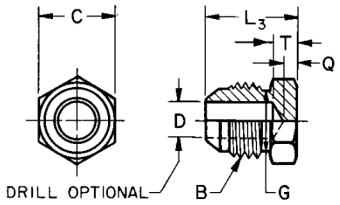


FIGURE 3D—PLUG (070109)

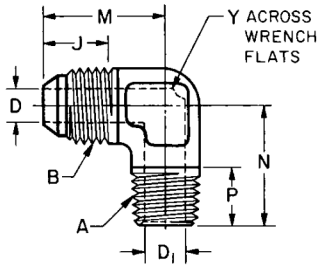


FIGURE 4A—90 DEGREE
MALE ELBOW (070202)

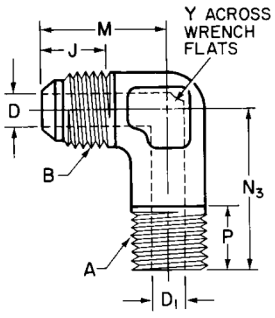


FIGURE 4B—90 DEGREE
MALE LONG ELBOW (071502)

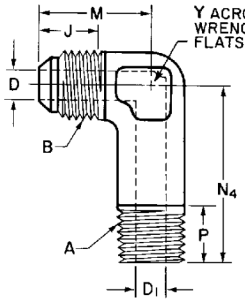


FIGURE 4C—90 DEGREE
MALE EXTRA LONG
ELBOW (071602)

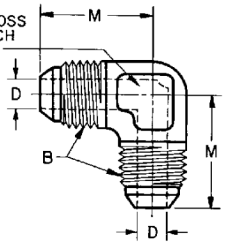


FIGURE 4D—90
DEGREE UNION
ELBOW (070201)

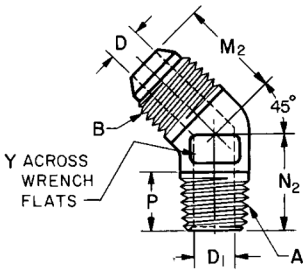


FIGURE 4E—45 DEGREE
MALE ELBOW (070302)

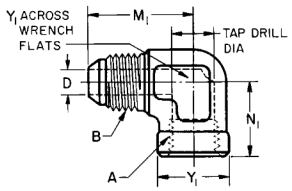


FIGURE 5A—90 DEGREE FEMALE ELBOW (070203)

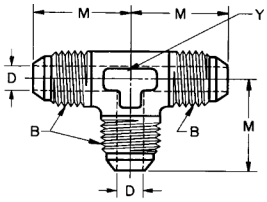


FIGURE 5B—UNION TEE (070401)

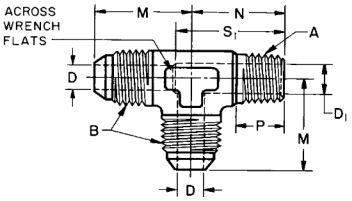


FIGURE 5C—MALE RUN TEE (070424)

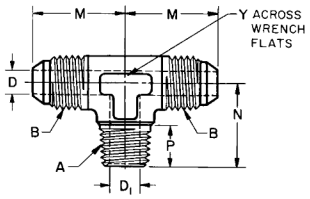


FIGURE 5D—MALE BRANCH TEE (070425)

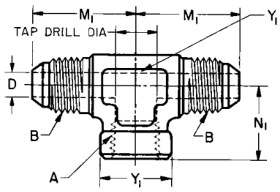


FIGURE 6A—FEMALE BRANCH TEE (070427)

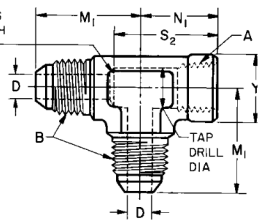


FIGURE 6B—FEMALE RUN TEE (070426)

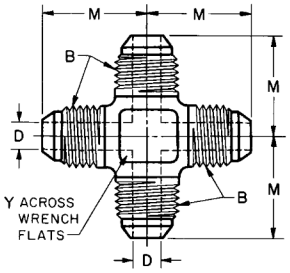


FIGURE 6C—CROSS (070501)

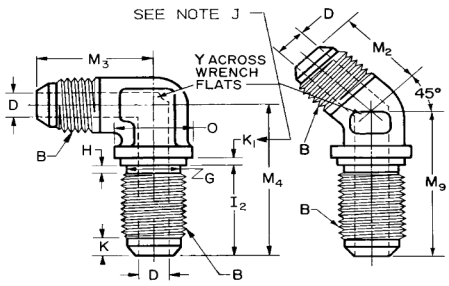


FIGURE 7A—90 DEGREE BULKHEAD ELBOW (070701)

FIGURE 7B—45 DEGREE BULKHEAD ELBOW (070801)

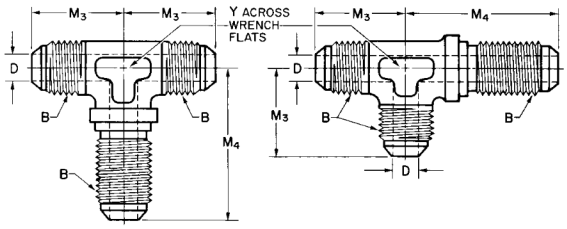


FIGURE 7C—BULKHEAD BRANCH TEE (070959)

FIGURE 7D—BULKHEAD RUN TEE (070958)

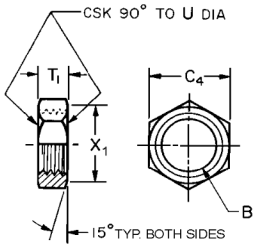


FIGURE 8A—STRAIGHT THREAD LOCKNUT* (070117)

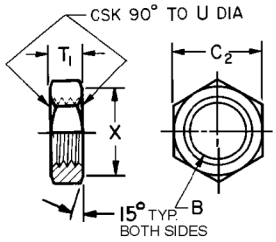


FIGURE 8B—BULKHEAD LOCKNUT (070118)

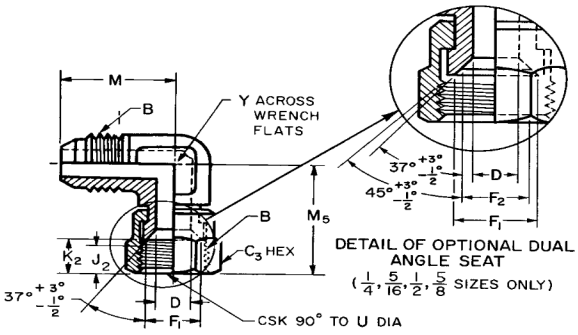


FIGURE 8C—90 DEGREE SWIVEL ELBOW (070221)

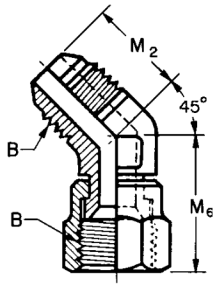


FIGURE 9A—45 DEGREE SWIVEL ELBOW (070321)

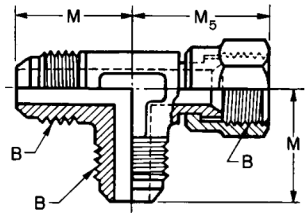


FIGURE 9B—SWIVEL RUN TEE (070432)

THE DESIGN AND METHOD OF ATTACHING THE SWIVEL NUT SHALL BE OPTIONAL WITH THE MANUFACTURER PROVIDING THE TABULATED DIMENSIONS ARE MAINTAINED AND THE NUT TURNS FREELY.

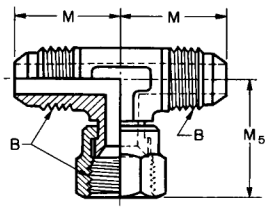


FIGURE 9C—SWIVEL BRANCH TEE (070433)

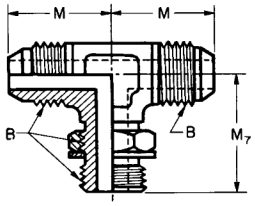
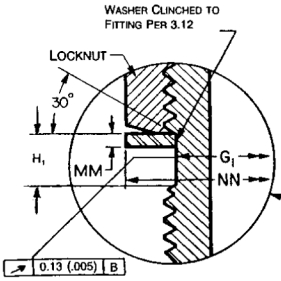


FIGURE 9D—STRAIGHT THREAD BRANCH TEE† (070429)



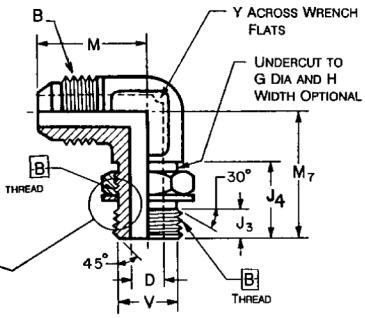


FIGURE 10A—90 DEGREE STRAIGHT THREAD ELBOW† (070220)

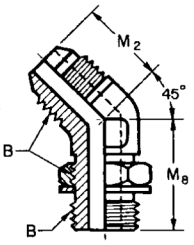


FIGURE 10B—45 DEGREE STRAIGHT THREAD ELBOW† (070320)

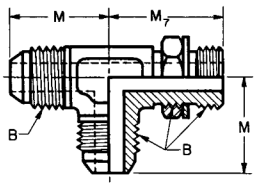


FIGURE 10C—STRAIGHT THREAD RUN TEE† (070428)

NOTES—UNSPECIFIED DETAIL WITH RESPECT TO DIMENSIONS, TOLERANCES, CONTOURS, MATERIAL, WORKMANSHIP, ETC., MUST CONFORM TO GENERAL SPECIFICATIONS FOR HYDRAULIC TUBE FITTINGS. THE DIMENSIONAL DESIGNATIONS FOR TUBE ENDS IN FIGURES 2A TO 10F, FOR SWIVEL ENDS IN FIGURES 8C TO 9C, FOR O-RING BOSS ENDS IN FIGURES 3B AND 3C, AND FOR ADJUSTABLE STRAIGHT THREAD ENDS IN FIGURES 9D TO 10F SHALL APPLY TO CORRESPONDING ENDS OF OTHER FIGURES ON THIS AND PRECEDING PAGE UNLESS SHOWN OTHERWISE. FIGURES 2A TO 10F ON THIS AND PRECEDING PAGE APPLY TO TABLE 4. CODES SHOWN IN BRACKETS ADJACENT TO FIGURE NUMBERS REPRESENT RESPECTIVE FITTING IDENTIFICATION IN ACCORDANCE WITH SAE J846.

*MODIFICATION OF 1/8-1 IN SIZES IN THESE TYPES OF FITTINGS FOR USE WITH MS 33649 (OR SUPERSEDED AND 10050) BOSSES IS SHOWN IN FIGURE 35 AND TABLE 15.

† IF DESIRED BY THE PURCHASER AND SO SPECIFIED, THESE FITTINGS MAY BE FURNISHED WITH LARGE HEXAGON LOCKNUT SHOWN IN FIGURE 8B.

TABLE 4—DIMENSIONS OF ALL BODIES AND LOCKNUTS (FIGURES 2A TO 10C)

Nom Tube OD, in	A Dryseal Pipe Thread SAE J476 (ANSI B1.20.3)	B[g] Thread Size, in SAE J425 (ISO R725) Class 2A Ext Class 2B Int	C[h] Hex Nom in	C_1[h] Hex Nom in	C_2[h] Hex Nom in	C_3[h] Hex Min in	C_4[h] Hex Nom in	D[i][m] Metric Drill Size mm	D[i] Drill in	D_1[b][i] Drill mm	D_1[b][i] Drill in	E Dia mm ±0.08	E Dia in ±0.003	F_1 Dia mm ±0.25	F_1 Dia in ±0.010	F_2 Dia mm ±0.13	F_2 Dia in ±0.005
1/8	1/8-27	5/16-24	7/16	9/16	9/16	7/16	7/16	1.6	0.062	4.8	0.188	2.11	0.083	4.85	0.190	—	—
3/16	1/8-27	3/8-24	7/16	9/16	5/8	1/2	1/2	3.2	0.125	4.8	0.188	3.71	0.146	6.20	0.245	—	—
1/4	1/8-27	7/16-20	1/2	9/16	11/16	9/16	9/16	4.4	0.172	4.8	0.188	4.90	0.193	7.35	0.290	6.35	0.250
5/16	1/8-27	1/2-20	9/16	9/16	3/4	5/8	5/8	6.0	0.234	4.8	0.188	6.48	0.255	8.90	0.350	7.93	0.312
3/8	1/4-18	9/16-18	5/8	3/4	13/16	11/16	11/16	7.5	0.297	7.0	0.281	8.08	0.318	10.90	0.430	—	—
1/2	3/8-18	3/4-16	13/16	7/8	1	7/8	7/8	9.9	0.391	10.3	0.406	10.82	0.426	14.35	0.565	12.70	0.500
5/8	1/2-14	7/8-14	15/16	1-1/8	1-1/8	1	1	12.3	0.484	13.5	0.531	13.69	0.539	17.15	0.675	15.88	0.625
3/4	3/4-14	1-1/16-12	1-1/8	1-3/8	1-3/8	1-1/4	1-1/4	15.5	0.609	18.3	0.719	16.87	0.664	21.45	0.845	—	—
7/8	3/4-14	1-3/16-12	1-1/4	1-3/8	1-1/2	1-3/8	1-3/8	18.3(18.0)	0.719	18.3	0.719	20.02	0.788	24.65	0.970	—	—
1	1-11-1/2	1-5/16-12	1-3/8	1-5/8	1-5/8	1-1/2	1-1/2	(21.5)21.4	0.844	23.8	0.938	23.19	0.913	27.80	1.095	—	—
1-1/4	1-1/4-11-1/2	1-5/8-12	1-11/16	2	1-7/8	2	1-7/8	(27.5)27.4	1.078	31.7	1.250	29.13	1.147	35.70	1.405	—	—
1-1/2	1-1/2-11-1/2	1-7/8-12	2	2-3/8	2-1/8	2-1/4	2-1/8	(33.5)33.3	1.312	38.0	1.500	35.08	1.381	41.15	1.620	—	—
2	2-11-1/2	2-1/2-12	2-5/8	2-7/8	2-3/4	2-7/8	2-3/4	45.2(45.0)	1.781	49.0	1.938	47.75	1.880	56.75	2.235	—	—

Nom Tube OD in	G Dia mm +0.05 −0.25	G Dia in +0.002 −0.010	G_1[a] Dia mm +0.05 −0.08	G_1[a] Dia in +0.002 −0.003	H mm +0.8 −0.0	H in +0.030 −0.000	H_1 mm +0.3 −0.0	H_1 in +0.010 −0.000	I mm ±0.4	I in ±0.016	I_1 mm ±0.5	I_1 in ±0.02	I_2 mm ±0.5	I_2 in ±0.02	I_3 mm ±0.13	I_3 in ±0.005	I_4 mm ±0.5	I_4 in ±0.02	J[k] Full Thread Min mm	J[k] Full Thread Min in
1/8	6.35	0.250	6.35	0.250	1.6	0.063	3.2	0.125	11.4	0.448	28.2	1.11	23.4	0.92	7.54	0.297	29.7	1.17	11.00	0.433
3/16	7.92	0.312	7.95	0.313	1.6	0.063	3.3	0.131	12.2	0.479	28.2	1.11	23.4	0.92	7.54	0.297	31.8	1.25	11.81	0.464
1/4	9.25	0.364	9.25	0.364	1.9	0.075	4.0	0.156	14.0	0.550	30.5	1.20	25.9	1.02	9.14	0.360	35.3	1.39	13.59	0.535
5/16	10.82	0.426	10.85	0.427	1.9	0.075	4.0	0.156	14.0	0.550	30.5	1.20	25.9	1.02	9.14	0.360	36.8	1.45	13.59	0.535
3/8	12.22	0.481	12.24	0.482	2.1	0.083	4.0	0.156	14.1	0.556	32.5	1.28	27.7	1.09	9.93	0.391	39.6	1.56	13.74	0.541
1/2	16.74	0.659	16.76	0.660	2.4	0.094	4.8	0.187	16.7	0.657	36.6	1.44	31.8	1.25	11.13	0.438	47.8	1.88	16.31	0.642
5/8	19.61	0.772	19.63	0.773	2.7	0.107	5.6	0.219	19.3	0.758	40.1	1.58	35.3	1.39	12.70	0.500	53.1	2.09	18.87	0.743
3/4	23.95	0.943	24.00	0.945	3.2	0.125	5.9	0.234	21.9	0.864	44.4	1.75	39.6	1.56	15.09	0.594	63.5	2.50	21.56	0.849
7/8	27.13	1.068	27.18	1.070	3.2	0.125	5.9	0.234	22.6	0.890	44.4	1.75	39.6	1.56	15.09	0.594	68.3	2.69	22.22	0.875
1	30.30	1.193	30.35	1.195	3.2	0.125	5.9	0.234	23.1	0.911	44.4	1.75	39.6	1.56	15.09	0.594	72.1	2.84	22.76	0.896
1-1/4	38.25	1.506	38.28	1.507	3.2	0.125	5.9	0.234	24.3	0.958	45.7	1.80	40.9	1.61	15.09	0.594	88.1	3.47	23.95	0.943
1-1/2	44.58	1.755	44.60	1.756	3.2	0.125	5.9	0.234	27.5	1.083	46.0	1.81	41.1	1.62	15.09	0.594	98.6	3.88	27.13	1.068
2	60.45	2.380	60.48	2.381	3.2	0.125	5.9	0.234	33.9	1.333	53.1	2.09	48.5	1.91	15.09	0.594	122.9	4.84	33.48	1.318

Continued on next page.

TABLE 4—DIMENSIONS OF ALL BODIES AND LOCKNUTS (FIGURES 2A TO 10C) (CONTINUED)

Nom Tube OD, in	J_2 Full Thread Min mm	J_2 Full Thread Min in	J_3 Full Thread mm ±0.13	J_3 Full Thread in ±0.005	J_4 Min mm	J_4 Min in	K mm +0.4 −0.0	K in +0.016 −0.000	K_1[j] mm ±0.5	K_1[j] in ±0.02	K_2 mm +0.8 −0.4	K_2 in +0.030 −0.016	L mm ±0.5	L in ±0.02	L_1 mm ±0.5	L_1 in ±0.02	L_2 mm ±0.5	L_2 in ±0.02	L_3 mm ±0.5	L_3 in ±0.02	L_4 mm ±0.5	L_4 in ±0.02
1/8	6.38	0.251	5.94	0.234	15.0	0.59	4.5	0.177	2.4	0.094	7.9	0.312	28.2	1.11	29.7	1.17	28.4	1.12	17.8	0.70	47.5	1.87
3/16	7.16	0.282	5.94	0.234	15.0	0.59	4.5	0.177	2.4	0.094	8.3	0.328	29.0	1.14	31.2	1.23	28.7	1.13	18.5	0.73	48.3	1.90
1/4	7.62	0.300	6.73	0.265	18.5	0.73	4.9	0.193	2.4	0.094	8.7	0.344	31.0	1.22	34.8	1.37	30.2	1.19	20.3	0.80	52.6	2.07
5/16	8.41	0.331	6.73	0.265	18.5	0.73	4.9	0.193	2.4	0.094	9.5	0.375	31.0	1.22	34.8	1.37	29.7	1.17	20.3	0.80	52.6	2.07
3/8	8.46	0.333	7.92	0.312	19.1	0.75	5.0	0.198	2.4	0.094	9.5	0.375	36.3	1.43	35.8	1.41	35.6	1.40	21.3	0.84	55.4	2.18
1/2	9.52	0.375	8.74	0.344	21.9	0.86	6.4	0.253	3.2	0.125	10.7	0.422	38.9	1.53	41.1	1.62	39.6	1.56	23.9	0.94	62.0	2.44
5/8	11.71	0.461	9.93	0.391	25.4	1.00	6.8	0.266	3.2	0.125	12.7	0.500	48.0	1.89	47.8	1.88	48.0	1.89	27.9	1.10	69.6	2.74
3/4	11.91	0.469	11.91	0.469	29.0	1.14	8.0	0.315	3.2	0.125	14.3	0.562	52.3	2.06	54.9	2.16	52.3	2.06	32.5	1.28	78.5	3.09
7/8	13.11	0.516	11.91	0.469	29.0	1.14	8.0	0.315	3.2	0.125	14.7	0.578	53.1	2.09	56.1	2.21	52.3	2.06	33.3	1.31	79.2	3.12
1	14.30	0.563	11.91	0.469	29.0	1.14	8.0	0.315	3.2	0.125	15.1	0.594	58.4	2.30	57.2	2.25	59.7	2.35	33.8	1.33	79.8	3.14
1-1/4	14.30	0.563	11.91	0.469	29.0	1.14	9.3	0.367	3.2	0.125	15.9	0.625	62.2	2.45	61.7	2.43	63.2	2.49	36.8	1.45	84.1	3.31
1-1/2	16.79	0.661	11.91	0.469	29.0	1.14	9.6	0.378	3.2	0.125	18.6	0.734	68.1	2.68	69.8	2.75	66.5	2.62	41.9	1.65	89.4	3.52
2	21.44	0.844	11.91	0.469	29.0	1.14	11.7	0.461	3.2	0.125	23.8	0.938	79.0	3.11	86.4	3.40	75.4	2.97	52.1	2.05	106.7	4.20

Nom Tube OD, in	L_5 mm ±0.5	L_5 in ±0.02	L_6 mm ±0.5	L_6 in ±0.02	M mm ±0.8	M in ±0.03	M_1 mm ±0.8	M_1 in ±0.03	M_2 mm ±0.8	M_2 in ±0.03	M_3 mm ±0.8	M_3 in ±0.03	M_4 mm ±0.8	M_4 in ±0.03	M_5 mm ±1.5	M_5 in ±0.06	M_6 mm ±1.5	M_6 in ±0.06	M_7 mm ±0.8	M_7 in ±0.03	M_8 mm ±0.8	M_8 in ±0.03	M_9 mm ±0.8	M_9 in ±0.03
1/8	26.9	1.06	45.5	1.79	19.6	0.77	25.4	1.00	17.5	0.69	22.4	0.88	38.1	1.50	24.6	0.97	23.9	0.94	23.9	0.94	22.4	0.88	36.1	1.42
3/16	27.9	1.10	47.5	1.87	21.1	0.83	26.2	1.03	17.5	0.69	23.9	0.94	38.1	1.50	25.4	1.00	23.9	0.94	23.9	0.94	22.4	0.88	36.1	1.42
1/4	31.2	1.23	52.8	2.08	22.6	0.89	27.4	1.08	18.3	0.72	24.6	0.97	40.4	1.59	25.4	1.00	23.9	0.94	26.2	1.03	26.7	1.05	38.9	1.53
5/16	31.2	1.23	54.4	2.14	24.1	0.95	27.4	1.08	19.6	0.77	26.9	1.06	43.7	1.72	26.9	1.06	25.4	1.00	28.7	1.13	26.7	1.05	42.2	1.66
3/8	33.0	1.30	58.7	2.31	26.9	1.06	31.2	1.23	21.1	0.83	27.7	1.09	46.0	1.81	31.8	1.25	28.4	1.12	31.8	1.25	29.0	1.14	42.4	1.67
1/2	37.6	1.48	68.6	2.70	31.8	1.25	36.1	1.42	24.9	0.98	34.5	1.36	53.6	2.11	35.1	1.38	32.5	1.28	36.8	1.45	33.0	1.30	49.3	1.94
5/8	43.2	1.70	77.2	3.04	36.8	1.45	41.7	1.64	28.2	1.11	39.6	1.56	60.7	2.39	41.1	1.62	36.6	1.44	43.2	1.70	38.6	1.52	55.1	2.17
3/4	50.0	1.97	91.7	3.61	42.2	1.66	48.0	1.89	32.5	1.28	45.2	1.78	67.8	2.67	44.4	1.75	38.1	1.50	49.3	1.94	43.9	1.73	62.0	2.44
7/8	50.5	1.99	96.5	3.80	45.7	1.80	47.2	1.86	36.8	1.45	48.8	1.92	71.1	2.80	45.2	1.78	41.1	1.62	50.8	2.00	47.2	1.86	63.5	2.50
1	51.8	2.04	101.1	3.98	46.0	1.81	55.1	2.17	37.3	1.47	49.3	1.94	71.1	2.80	50.8	2.00	44.4	1.75	52.1	2.05	47.2	1.86	65.0	2.56
1-1/4	55.1	2.17	119.1	4.69	52.3	2.06	59.2	2.33	40.4	1.59	55.1	2.17	79.2	3.12	58.7	2.31	51.6	2.03	57.2	2.25	48.5	1.91	67.3	2.65
1-1/2	60.2	2.37	131.3	5.17	59.2	2.33	73.4	2.89	45.2	1.78	59.4	2.34	86.9	3.42	65.8	2.59	57.2	2.25	60.7	2.39	48.5	1.91	67.8	2.67
2	70.6	2.78	159.8	6.29	77.7	3.06	83.8	3.30	56.4	2.22	73.4	2.89	104.4	4.11	85.9	3.38	73.9	2.91	73.4	2.89	47.2	1.86	73.9	2.91

Nom Tube OD, in	N mm ±0.8	N in ±0.03	N_1 mm ±0.8	N_1 in ±0.03	N_2 mm ±0.8	N_2 in ±0.03	N_3 mm ±0.8	N_3 in ±0.03	N_4 mm ±0.8	N_4 in ±0.03	O mm ±0.8	O in ±0.03	P Min mm	P Min in	P_1 Max mm	P_1 Max in	Q Min mm	Q Min in	$S^{(b)}$ Max mm	$S^{(b)}$ Max in	S_1[(b)(c)] Min mm	S_1[(b)(c)] Min in	S_2[(c)] Min mm	S_2[(c)] Min in
1/8	18.3	0.72	16.8	0.66	13.2	0.52	25.4	1.00	32.5	1.28	11.1	0.438	9.7	0.38	11.7	0.46	2.8	0.11	12.4	0.49	20.1	0.79	18.5	0.73
3/16	18.3	0.72	16.8	0.66	13.2	0.52	26.4	1.04	34.3	1.35	12.7	0.500	9.7	0.38	11.7	0.46	2.8	0.11	12.4	0.49	20.8	0.82	19.3	0.76
1/4	19.8	0.78	16.8	0.66	16.3	0.64	29.7	1.17	39.6	1.56	14.3	0.562	9.7	0.38	11.7	0.46	2.8	0.11	12.4	0.49	23.1	0.91	20.1	0.79
5/16	19.8	0.78	16.8	0.66	16.3	0.64	29.7	1.17	41.4	1.63	15.9	0.625	9.7	0.38	11.7	0.46	3.0	0.12	16.3	0.64	28.2	1.11	20.8	0.82
3/8	27.7	1.09	22.4	0.88	21.8	0.86	40.1	1.58	52.6	2.07	17.5	0.688	14.2	0.56	17.0	0.67	3.0	0.12	17.0	0.67	31.8	1.25	27.2	1.07
1/2	31.0	1.22	25.9	1.02	24.1	0.95	46.2	1.82	61.5	2.42	22.2	0.875	14.2	0.56	17.3	0.68	4.1	0.16	17.3	0.68	37.1	1.46	32.0	1.26
5/8	37.3	1.47	31.2	1.23	29.7	1.17	55.1	2.17	72.9	2.87	25.4	1.000	19.0	0.75	22.9	0.90	4.1	0.16	23.1	0.91	44.4	1.75	38.4	1.51
3/4	40.4	1.59	34.5	1.36	30.5	1.20	62.0	2.44	83.3	3.28	30.2	1.188	19.0	0.75	23.1	0.91	4.8	0.19	23.9	0.94	49.3	1.94	43.4	1.71
7/8	42.9	1.69	36.1	1.42	33.02	1.30	65.8	2.59	88.9	3.50	33.3	1.312	19.0	0.75	23.1	0.91	4.8	0.19	—	—	—	—	46.2	1.82
1	50.0	1.97	41.1	1.62	37.6	1.48	76.5	3.01	102.9	4.05	36.5	1.438	23.9	0.94	29.0	1.14	4.8	0.19	28.7	1.13	61.7	2.43	52.8	2.08
1-1/4	60.5	2.38	43.2	1.70	42.4	1.67	93.7	3.69	127.0	5.00	44.4	1.750	24.6	0.97	29.5	1.16	5.8	0.23	30.5	1.20	75.2	2.96	57.9	2.28
1-1/2	67.1	2.64	52.8	2.08	45.0	1.77	104.1	4.10	141.0	5.55	50.8	2.000	25.4	1.00	29.5	1.16	5.8	0.23	32.3	1.27	84.8	3.34	70.6	2.78
2	76.2	3.00	60.7	2.39	53.6	2.11	122.2	4.81	168.4	6.63	66.7	2.625	26.2	1.03	30.0	1.18	8.4	0.33	34.8	1.37	100.1	3.94	84.6	3.33

Continued on next page.

TABLE 4—DIMENSIONS OF ALL BODIES AND LOCKNUTS (FIGURES 2A TO 10C) (CONTINUED)

Nom Tube OD, in	T[d] Ref mm	T[d] Ref in	T_1 mm ±0.5	T_1 in ±002	T_2[d] Ref mm	T_2[d] Ref in	U Dia mm +0.4 –0.0	U Dia in +0.016 –0.000	V Dia mm ±0.25	V Dia in ±0.010	X Dia mm ±0.13	X Dia in ±0.005	X_1 Dia mm ±0.13	X_1 Dia in ±0.005
1/8	5.6	0.22	5.6	0.22	7.1	0.28	8.1	0.317	6.25	0.245	14.27	0.562	11.13	0.438
3/16	5.6	0.22	5.6	0.22	7.1	0.28	9.7	0.380	7.75	0.305	15.88	0.625	12.70	0.500
1/4	5.6	0.22	7.1	0.28	7.1	0.28	11.3	0.443	9.15	0.360	17.48	0.688	14.30	0.563
5/16	5.6	0.22	7.1	0.28	7.1	0.28	12.8	0.505	10.65	0.420	19.05	0.750	15.88	0.625
3/8	6.4	0.25	6.9	0.27	7.9	0.31	14.4	0.567	12.05	0.475	20.62	0.812	17.48	0.688
1/2	6.4	0.25	7.9	0.31	8.6	0.34	19.2	0.755	16.65	0.655	25.40	1.000	22.22	0.875
5/8	7.9	0.31	9.1	0.36	10.2	0.40	22.4	0.880	19.55	0.770	28.58	1.125	25.40	1.000
3/4	9.7	0.38	10.4	0.41	11.9	0.47	27.1	1.067	23.90	0.940	34.92	1.375	31.75	1.250
7/8	9.7	0.38	10.4	0.41	11.9	0.47	30.3	1.193	27.05	1.065	38.10	1.500	34.92	1.375
1	9.7	0.38	10.4	0.41	12.7	0.50	33.5	1.317	30.25	1.190	41.28	1.625	38.10	1.500
1-1/4	11.7	0.46	10.4	0.41	14.7	0.58	41.4	1.630	38.10	1.500	47.62	1.875	47.62	1.875
1-1/2	13.5	0.53	10.4	0.41	16.5	0.65	47.8	1.880	44.45	1.750	53.98	2.125	53.98	2.125
2	17.3	0.68	10.4	0.41	20.6	0.81	63.6	2.505	60.35	2.375	69.85	2.750	69.85	2.750

Nom Tube OD, in	Y Forging[f], mm +0.0	Y Forging[f], in +0.000	Y[f] Barstock Max mm	Y[f] Barstock Max in	Y_1[e][f] mm +0.0	Y_1[e][f] in +0.000	MM mm ±0.08	MM in ±0.003	NN Dia mm ±0.4	NN Dia in ±0.016	PP Dia mm ±0.25	PP Dia in ±0.010
1/8	11.1-0.8	0.438-0.030	—	—	14.3-0.8	0.562-0.030	0.76	0.030	12.8	0.504	6.25	0.245
3/16	11.1-0.8	0.438-0.030	—	—	14.3-0.8	0.562-0.030	0.76	0.030	14.6	0.575	7.75	0.305
1/4	11.1-0.8	0.438-0.030	14.3	0.562	14.3-0.8	0.562-0.030	0.89	0.035	16.5	0.650	9.15	0.360
5/16	14.3-0.8	0.562-0.030	15.9	0.625	14.3-0.8	0.562-0.030	0.89	0.035	18.3	0.722	10.65	0.420
3/8	14.3-0.8	0.562-0.030	20.6	0.812	19.0-0.8	0.750-0.030	0.89	0.035	20.2	0.794	12.05	0.475
1/2	19.0-0.8	0.750-0.030	22.2	0.875	22.2-0.8	0.875-0.030	1.04	0.041	25.7	1.010	16.65	0.655
5/8	22.2-0.8	0.875-0.030	28.6	1.125	27.0-0.8	1.062-0.030	1.27	0.050	29.3	1.155	19.55	0.770
3/4	27.0-1.0	1.062-0.040	34.9	1.375	33.3-1.0	1.312-0.040	1.27	0.050	36.7	1.444	23.90	0.940
7/8	33.3-1.0	1.312-0.040	38.1	1.500	33.3-1.0	1.312-0.040	1.27	0.050	40.4	1.589	27.05	1.065
1	33.3-1.0	1.312-0.040	41.3	1.625	41.3-1.0	1.625-0.040	1.27	0.050	44.0	1.732	30.25	1.190
1-1/4	41.3-1.0	1.625-0.040	54.0	2.125	47.6-1.0	1.875-0.040	1.27	0.050	55.0	2.165	38.10	1.500
1-1/2	47.6-1.0	1.875-0.040	57.2	2.250	65.1-1.0	2.562-0.040	1.27	0.050	62.3	2.454	44.45	1.750
2	63.5-1.0	2.500-0.040	82.6	3.250	71.4-1.0	2.812-0.040	1.27	0.050	80.3	3.160	—	—

a O-ring groove undercut must be smooth and free from tool marks.
b At manufacturer's option, through passages in Figures 2A and 5C may conform with the smaller diameter specified or the appropriate end may be counterbored to the larger diameter for depths S and S_1, respectively.
c Maximum depth shall be optional with manufacturer providing wall thickness is controlled with General Specifications.
d Minimum design thickness, not subject to inspection.
e The basic dimensions shown shall apply as minimum for boss diameters.
f For optional metric fitting flats see Appendix A.
g Unified class 2B thread shall apply to swivel nuts Figures 8C to 9C and with minor diameter modified to class 3B limits for locknuts Figures 8A and 8B.
h Across flat widths must fit standard wrench openings. See ANSI B18.2.2.
j Diameter of bulkhead pilot is the same as major thread diameter. Recommended pilot hole for bulkhead fittings is 0.4 mm (0.016 in) over major thread diameter.
k J full thread minimum with thread runout. If undercut to G diameter and H width. Length of thread and undercut must not be less than l.
l See Table 1A for tolerance.
m At Manufacturers option, alternate metric drills shown in brackets with corresponding tolerances may be used.

TABLE 4A—ADDED VALUES FOR L, LL, AND LLL DROP LENGTHS (REF. FIGURES 10D (071520), 10E (071620), 10F (071720)

SAE Dash Size	M11 mm ±0.8	M11 in ±0.030	M12 mm ±0.8	M12 in ±0.030	M13 mm ±0.8	M13 in ±0.030
–2	33.27	1.31	37.34	1.47	51.56	2.03
–3	35.31	1.39	38.86	1.53	53.85	2.12
–4	39.12	1.54	43.94	1.73	61.98	2.44
–5	39.88	1.57	47.24	1.86	66.29	2.61
–6	42.16	1.66	52.83	2.08	73.91	2.91
–8	50.04	1.97	62.99	2.48	89.66	3.53
–10	57.40	2.26	73.41	2.89	102.87	4.05
–12	66.55	2.62	84.84	3.34	120.65	4.75
–14	70.10	2.76	90.42	3.56	129.29	5.09
–16	77.72	3.06	94.49	3.72	136.91	5.39
–20	88.39	3.48	112.01	4.41	166.62	6.56
–24	99.82	3.93	122.17	4.81	183.64	7.23
–32	113.28	4.46	151.89	5.98	230.63	9.08

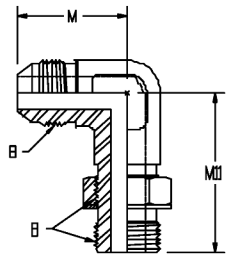


FIGURE 10D—90 DEGREE STRAIGHT THREAD ELBOW LONG (071520)

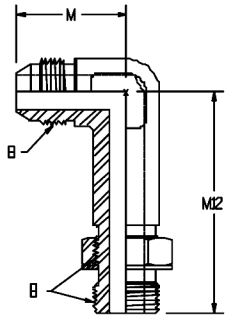


FIGURE 10E—90 DEGREE STRAIGHT THREAD ELBOW EXTRA LONG (071620)

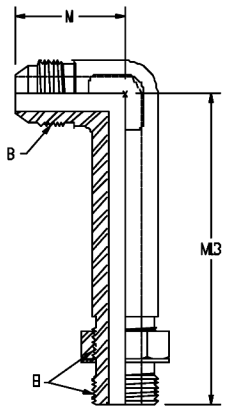
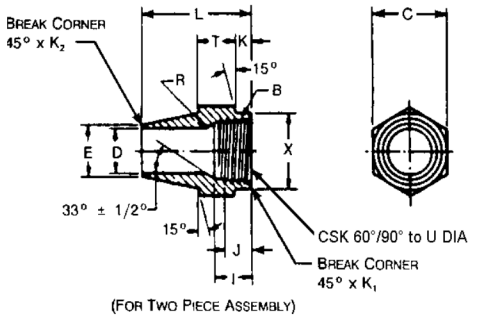
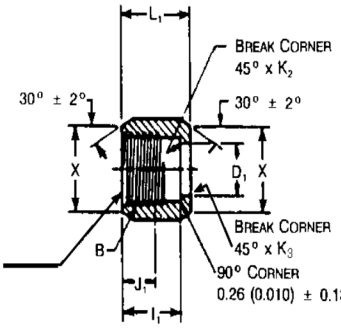


FIGURE 10F—90 DEGREE STRAIGHT THREAD ELBOW EXTRA EXTRA LONG (072120)



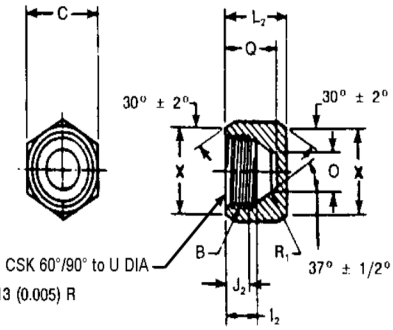
(FOR TWO PIECE ASSEMBLY)

FIGURE 11—LONG NUT (070111)



(FOR THREE PIECE ASSEMBLY)

FIGURE 12—SHORT NUT (070110)



(OUTSIDE CONTOUR OPTIONAL WITH MANUFACTURER)

FIGURE 13—CAP (070112)

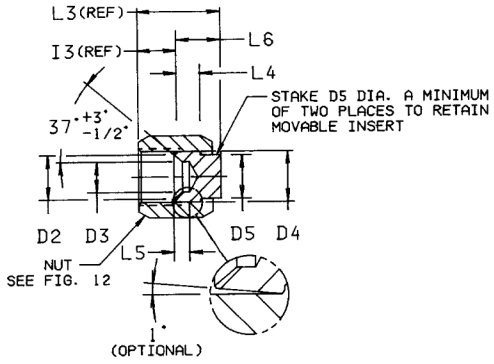


FIGURE 13—CAP ASSEMBLY (MOVEABLE INSERT) (070112A)

TABLE 5—DIMENSIONS OF STYLE A AND B NUTS AND CAPS (FIGURES 11 TO 13A)

Nom Tube, OD in	B Thread Size, in SAE J475 (ISO R725) Class 2B Int	Thread[b] Minor Dia mm +0.13 –0.00	Thread[b] Minor Dia in +0.005 –0.000	C[a] Hex Min in	D Dia mm +0.8 –0.00	D Dia in +0.003 –0.000	D_1 Dia mm	D_1 Dia tol –0.00	D_1 Dia in	D_1 Dia tol –0.000	D_2 Dia mm 0.25	D_2 Dia in 0.01	D_3 Dia mm	D_3 Dia in	D_4 Dia mm +0.08 –0.00	D_4 Dia in +0.003 –0.000	D_5 Dia mm +0.13 –0.00	D_5 Dia in +0.005 –0.000
1/8	5/16-24	6.91	0.272	3/8	3.30	0.130	4.55	+0.10	0.179	+0.004	4.85	0.19	2.39	0.094	6.71	0.264	4.24	0.167
3/16	3/8-24	8.48	0.334	7/16	4.90	0.193	6.12	+0.10	0.241	+0.004	6.2	0.245	3.96	0.156	8.28	0.326	5.82	0.229
1/4	7/16-20	9.86	0.388	9/16	6.48	0.255	7.72	+0.10	0.304	+0.004	7.35	0.29	4.37	0.172	9.65	0.380	7.42	0.292
5/16	1/2-20	11.46	0.451	5/8	8.08	0.318	9.47	+0.10	0.373	+0.004	8.9	0.35	5.94	0.234	11.23	0.442	9.17	0.361
3/8	9/16-18	12.90	0.508	11/16	9.65	0.380	11.15	+0.10	0.439	+0.004	10.9	0.43	7.54	0.297	12.68	0.499	10.85	0.427
1/2	3/4-16	17.48	0.688	7/8	12.83	0.505	14.43	+0.13	0.568	+0.005	14.35	0.565	9.93	0.391	17.25	0.679	14.15	0.557
5/8	7/8-14	20.42	0.804	1	16.03	0.631	17.68	+0.13	0.696	+0.005	17.15	0.675	12.29	0.484	20.17	0.794	17.40	0.685
3/4	1-1/16-12	24.87	0.979	1-1/4	19.20	0.756	21.13	+0.13	0.832	+0.005	21.45	0.845	14.27	0.562	24.61	0.969	20.85	0.821
3/4[c] SPL	1-1/16-12	24.87	0.979	1-1/4	—	—	21.84	+0.13	0.860	+0.005	—	—	—	—	—	—	—	—
7/8	1-3/16-12	28.04	1.104	1-3/8	22.38	0.881	24.36	+0.13	0.959	+0.005	24.65	0.97	18.26	0.719	27.78	1.094	24.08	0.948
1	1-5/16-12	31.22	1.229	1-1/2	25.55	1.006	27.61	+0.13	1.087	+0.005	27.8	1.095	21.44	0.844	30.96	1.219	27.33	1.076
1-1/4	1- 5/8-12	39.14	1.541	2	32.00	1.260	34.14	+0.15	1.344	+0.006	35.7	1.405	27.38	1.078	38.88	1.531	33.88	1.334
1-1/2	1- 7/8-12	45.49	1.791	2-1/4	38.35	1.510	41.00	+0.15	1.614	+0.006	41.15	1.62	33.32	1.312	45.24	1.781	40.73	1.604
2	2- 1/2-12	61.37	2.416	2-7/8	51.16	2.014	54.97	+0.15	2.164	+0.006	56.75	2.235	45.23	1.781	61.11	2.406	54.71	2.154

Continued on next page.

TABLE 5—DIMENSIONS OF STYLE A AND B NUTS AND CAPS (FIGURES 11 TO 13A) (CONTINUED)

E Dia mm +0.13 −0.00	E Dia in +0.005 −0.000	I mm ±0.13	I in ±0.005	I_1 mm ±0.3	I_1 in ±0.010	I_2 mm ±0.13	I_2 in ±0.005	I_3 mm Ref	I_3 in Ref	J Full Thread Min mm	J Full Thread Min in	J_1 Full Thread Min mm	J_1 Full Thread Min in	J_2 Full Thread Min mm	J_2 Full Thread Min in	K mm ±0.5	K in ±0.02	K_1 mm ±0.13	K_1 in ±0.005	K_2 mm ±0.13	K_2 in ±0.005
4.65	0.183	7.16	0.282	11.7	0.460	5.94	0.234	5.74	0.226	5.5	0.215	6.2	0.246	4.2	0.167	2.3	0.09	0.25	0.010	0.13	0.005
6.25	0.246	7.95	0.313	12.9	0.506	6.76	0.266	7.29	0.287	6.2	0.246	7.0	0.277	5.0	0.198	2.3	0.09	0.25	0.010	0.13	0.005
7.82	0.308	9.52	0.375	13.5	0.532	8.33	0.328	8.36	0.329	7.5	0.295	7.5	0.295	6.2	0.245	2.3	0.09	0.25	0.010	0.13	0.005
9.42	0.371	9.52	0.375	14.7	0.579	8.74	0.344	9.14	0.360	7.5	0.295	8.3	0.326	6.6	0.261	2.3	0.09	0.25	0.010	0.13	0.005
11.00	0.433	9.78	0.385	15.3	0.603	8.74	0.344	8.56	0.337	7.5	0.297	8.3	0.328	6.6	0.261	2.3	0.09	0.25	0.010	0.25	0.010
14.17	0.558	11.13	0.438	18.4	0.723	9.52	0.375	10.41	0.410	8.6	0.339	9.4	0.370	7.0	0.276	3.0	0.12	0.25	0.010	0.25	0.010
17.63	0.694	13.23	0.521	20.8	0.817	11.91	0.469	13.61	0.536	10.4	0.409	11.6	0.456	9.0	0.354	4.8	0.19	0.25	0.010	0.25	0.010
21.06	0.829	15.09	0.594	22.0	0.868	12.70	0.500	14.91	0.587	11.8	0.464	11.8	0.464	9.4	0.370	4.8	0.19	0.25	0.010	0.25	0.010
—	—	—	—	22.0	0.868	—	—	—	—	11.8	0.464	—	—	—	—	—	—	—	—	—	—
24.49	0.964	15.09	0.594	23.2	0.914	13.49	0.531	16.08	0.633	11.8	0.464	13.0	0.511	10.2	0.401	4.8	0.19	0.25	0.010	0.25	0.010
27.91	1.099	15.88	0.625	24.4	0.962	14.30	0.563	16.89	0.665	12.6	0.495	14.2	0.558	11.0	0.433	4.8	0.19	0.25	0.010	0.25	0.010
34.37	1.353	15.88	0.625	25.8	1.017	14.30	0.563	16.31	0.642	12.6	0.495	14.2	0.558	11.0	0.433	6.4	0.25	0.25	0.010	0.25	0.010
40.72	1.603	17.98	0.708	29.7	1.170	16.66	0.656	19.41	0.764	14.7	0.578	16.7	0.656	13.4	0.526	6.4	0.25	0.25	0.010	0.25	0.010
54.03	2.127	22.22	0.875	37.1	1.462	21.03	0.828	22.45	0.884	18.9	0.745	21.3	0.839	17.7	0.698	7.9	0.31	0.38	0.015	0.38	0.015

K_3 mm Max	K_3 in Max	L mm ±0.5	L in ±0.02	L_1 mm ±0.5	L_1 in ±0.020	L_2 mm ±0.3	L_2 in ±0.01	L_3 mm Ref	L_3 in Ref	L_4 mm ±0.4	L_4 in ±0.016	L_5 mm ±0.4	L_5 in ±0.016	L_6 mm ±0.4	L_6 in ±0.016	O Dia mm ±0.13	O Dia in ±0.005	Q mm ±0.3	Q in ±0.010
0.5	0.020	21.3	0.84	14.0	0.550	12.7	0.500	15.27	0.601	5.9	0.234	3.2	0.125	9.5	0.375	1.57	0.062	11.1	0.438
0.5	0.020	23.9	0.94	15.5	0.610	14.3	0.562	16.81	0.662	5.6	0.219	3.2	0.125	9.5	0.375	3.18	0.125	12.7	0.500
0.5	0.020	25.4	1.00	15.8	0.620	15.1	0.594	17.09	0.673	5.2	0.203	3.2	0.125	8.7	0.344	4.37	0.172	13.5	0.531
0.5	0.020	26.9	1.06	17.3	0.680	15.5	0.609	19.46	0.766	5.6	0.219	3.6	0.141	10.3	0.406	5.94	0.234	13.9	0.547
0.5	0.020	27.7	1.09	18.5	0.730	15.9	0.625	20.47	0.806	6.8	0.266	4.0	0.156	11.9	0.469	7.54	0.297	14.3	0.562
0.5	0.020	32.5	1.28	21.6	0.850	19.0	0.750	23.93	0.942	8.0	0.313	4.4	0.172	13.5	0.531	9.93	0.391	15.9	0.625
1.0	0.040	37.6	1.48	24.9	0.980	21.4	0.844	27.10	1.067	7.1	0.281	4.8	0.188	13.5	0.531	12.29	0.484	18.3	0.719
1.0	0.040	42.2	1.66	26.2	1.030	23.0	0.906	31.57	1.243	7.1	0.281	8.0	0.313	16.7	0.656	15.47	0.609	19.8	0.781
1.0	0.040	—	—	26.2	1.030	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1.0	0.040	46.0	1.81	27.7	1.090	24.6	0.969	31.95	1.258	7.1	0.281	6.4	0.250	15.9	0.625	18.26	0.719	21.4	0.844
1.0	0.40	49.3	1.94	28.7	1.130	25.8	1.016	32.76	1.290	7.6	0.297	5.6	0.219	15.9	0.625	21.44	0.844	21.8	0.859
1.0	0.40	55.6	2.19	31.2	1.230	27.0	1.062	35.35	1.392	9.5	0.375	7.1	0.281	19.1	0.750	27.38	1.078	23.0	0.906
1.0	0.40	58.7	2.31	36.1	1.420	30.2	1.188	43.20	1.701	10.3	0.406	9.5	0.375	23.8	0.938	33.32	1.312	26.2	1.031
1.0	0.40	69.8	2.75	44.5	1.750	36.5	1.438	52.60	2.071	14.7	0.578	10.3	0.406	30.1	1.188	45.24	1.781	32.5	1.281

Continued on next page.

TABLE 5—DIMENSIONS OF STYLE A AND B NUTS AND CAPS (FIGURES 11 TO 13A) (CONTINUED)

R Rad mm ±0.3	R Rad in ±0.01	R_1 Rad mm ±0.3	R_1 Rad in ±0.01	T mm ±0.5	T in ±0.02	U Dia mm +0.4 −0.0	U Dia in +0.016 −0.000	X mm ±0.3	X in ±0.01
0.8	0.03	0.8	0.03	6.4	0.25	8.05	0.317	9.1	0.36
0.8	0.03	0.8	0.03	6.9	0.27	9.65	0.380	10.7	0.42
0.8	0.03	0.8	0.03	8.4	0.33	11.25	0.443	13.7	0.54
0.8	0.03	0.8	0.03	8.4	0.33	12.83	0.505	15.2	0.60
1.3	0.05	1.5	0.06	8.6	0.34	14.40	0.567	17.0	0.67
1.5	0.06	1.5	0.06	11.4	0.45	19.18	0.755	21.8	0.86
1.5	0.06	1.5	0.06	13.2	0.52	22.35	0.880	24.9	0.98
2.0	0.08	1.5	0.06	16.3	0.64	27.10	1.067	31.5	1.24
2.3	0.09	1.5	0.06	17.5	0.69	30.30	1.193	34.5	1.36
—	—	—	—	—	—	30.30	1.193	34.5	1.36
2.3	0.09	1.5	0.06	18.5	0.73	33.45	1.317	37.6	1.48
2.3	0.09	1.5	0.06	18.5	0.73	41.40	1.630	50.3	1.98
2.8	0.11	1.5	0.06	21.1	0.83	47.75	1.880	56.9	2.24
2.8	0.11	1.5	0.06	23.4	0.92	63.63	2.505	72.6	2.86

a Across flat widths must fit standard wrench openings.
b Modified minor diameter.
c For use with 20 mm sleeve specified in Table 6A.

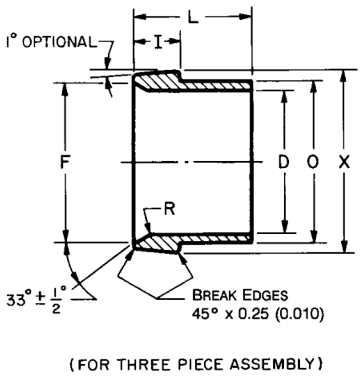


FIGURE 14—SLEEVE (070115)

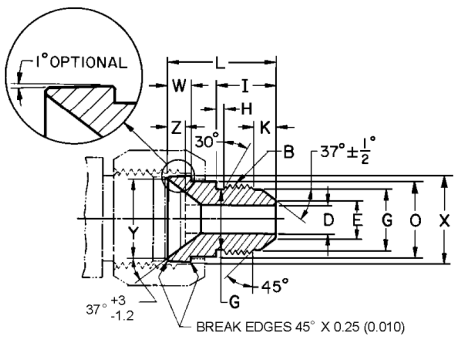


FIGURE 15—REDUCING ADAPTER WITHOUT LARGE NUT (070123)

TABLE 6—DIMENSIONS FOR SLEEVES (FIGURE 14) FOR INCH TUBING

Nom Tube OD, in	D Dia mm +0.08 −0.00	D Dia in +0.003 −0.000	F Dia mm ±0.13	F Dia in ±0.005	I mm ±0.5	I in ±0.02	L mm ±0.5	L in ±0.02	O Dia mm +0.00 −0.08	O Dia in +0.000 −0.003	R Rad mm ±0.3	R Rad in ±0.01	X Dia mm +0.00 −0.08	X Dia in +0.000 −0.003
1/8	3.30	0.130	5.21	0.205	3.0	0.12	8.6	0.34	4.37	0.172	0.8	0.031	6.78	0.267
3/16	4.90	0.193	6.78	0.267	3.6	0.14	8.6	0.34	5.94	0.234	0.8	0.031	8.36	0.329
1/4	6.48	0.255	8.00	0.315	3.6	0.14	10.4	0.41	7.54	0.297	0.8	0.031	9.73	0.383
5/16	8.08	0.318	9.52	0.375	4.1	0.16	11.2	0.44	9.30	0.366	0.8	0.031	11.30	0.445
3/8	9.65	0.380	11.20	0.441	4.3	0.17	12.7	0.50	10.97	0.432	1.2	0.047	12.75	0.502
1/2	12.83	0.505	14.96	0.589	5.6	0.22	14.2	0.56	14.27	0.562	1.6	0.062	17.32	0.682
5/8	16.03	0.631	17.91	0.705	6.1	0.24	16.8	0.66	17.53	0.690	1.6	0.062	20.24	0.797
3/4	19.20	0.756	22.35	0.880	6.6	0.26	17.3	0.68	20.98	0.826	2.0	0.078	24.69	0.972
7/8	22.38	0.881	25.53	1.005	6.6	0.26	19.3	0.76	24.21	0.953	2.4	0.094	27.86	1.097
1	25.55	1.006	28.70	1.130	7.1	0.28	19.8	0.78	27.46	1.081	2.4	0.094	31.04	1.222
1-1/4	32.00	1.260	35.86	1.412	7.9	0.31	23.1	0.91	34.01	1.339	2.4	0.094	38.96	1.534
1-1/2	38.35	1.510	41.40	1.630	8.6	0.34	28.4	1.12	40.87	1.609	2.8	0.109	45.31	1.784
2	51.16	2.014	55.75	2.195	10.4	0.41	30.2	1.19	54.84	2.159	2.8	0.109	61.19	2.409

TABLE 6A—DIMENSIONS FOR SLEEVES (FIGURE 14) FOR METRIC TUBING[c]

Nom Tube OD, mm	D Dia mm 0.08 –0.00	D Dia in +0.003 –0.000	F Dia mm ±0.13	F Dia in ±0.005	I mm ±0.5	I in ±0.02	L mm ±0.5	L in ±0.02	O Dia mm +0.00 –0.08	O Dia in +0.000 –0.003	R Rad in ±0.30	R Rad in ±0.010	X Dia mm +0.00 –0.08	X Dia in +0.000 –0.003	In Size Body[a] and Nut
6	6.13	0.241	8.00	0.315	3.6	0.14	10.4	0.41	7.54	0.297	0.80	0.031	9.73	0.383	1/4
8	8.13	0.320	9.52	0.375	4.1	0.16	11.2	0.44	9.30	0.366	0.80	0.031	11.30	0.445	5/16
10	10.13	0.399	11.20	0.441	4.3	0.17	12.7	0.50	10.97	0.432	1.20	0.047	12.75	0.502	3/8
12	12.13	0.478	14.96	0.589	5.6	0.22	14.2	0.56	14.27	0.562	1.60	0.062	17.32	0.682	1/2
16	16.15	0.636	17.91	0.705	6.1	0.24	16.8	0.66	17.53	0.690	1.60	0.062	20.24	0.797	5/8
19[b]	19.20	0.756	22.35	0.880	6.6	0.26	17.3	0.68	20.98	0.826	2.00	0.078	24.69	0.972	3/4
20[d],[e]	20.15	0.793	22.6	0.886	6.6	0.26	17.3	0.68	21.64	0.852	2.00	0.078	24.69	0.972	3/4 SPL
20	20.15	0.793	25.53	1.005	6.6	0.26	19.3	0.76	24.21	0.953	2.40	0.094	27.86	1.097	7/8
25	25.15	0.990	28.70	1.130	7.1	0.28	19.8	0.78	27.46	1.081	2.40	0.094	31.04	1.222	1
32	32.25	1.270	35.86	1.412	7.9	0.31	23.1	0.91	34.01	1.339	2.40	0.094	38.96	1.534	1-1/4
38[b]	38.35	1.510	41.40	1.630	8.6	0.34	28.4	1.12	40.87	1.609	2.80	0.109	45.31	1.784	1-1/2
50	50.36	1.983	55.75	2.195	10.4	0.41	30.2	1.19	54.84	2.159	2.80	0.109	61.19	2.409	2

[a] With the exception of the 20 mm tube sleeve which requires use of the 3/4 SPL nut (footnote d), metric sleeves are used with standard Figure 12 (070110) tube nuts and standard fitting bodies shown in Figures 2a to 10c (Table 4) and Figure 15 (Table 7).
[b] 19 mm and 38 mm are shown only because they use the standard 3/4 and 1-1/2 size Figure 14 sleeve and there is aparent usage.
[c] In addition to plating, sleeves for metric tubing will be dyed blue for identification.
(d) Designed for use with a 3/4 SPL nut which is equivalent to the –12 nut shown in Figure 12, Table 5 with the D_1 diameter modified to 0.860 + 0.005/–0.000.
(e) Technically equivalent to the 20 mm tube sleeve specified in ISO 8434-2.

TABLE 7—DIMENSIONS[a] OF REDUCING ADAPTER (FIGURE 15)

Tube Reduction, in	D Dia Ref mm	D Dia Ref in	L mm ±0.5	L in ±0.02	O Dia mm +0.00 –0.08	O Dia in +0.000 –0.003	W mm ±0.5	W in ±0.02	X Dia mm +0.00 –0.08	X Dia in +0.00 –0.003	Y Dia mm +0.13 –0.40	Y Dia in +0.005 –0.016	Z mm ±0.5	Z in ±0.02
3/8 x 1/4	4.4	0.172	24.6	0.97	10.97	0.432	4.3	0.17	12.75	0.502	11.20	0.441	—	—
1/2 x 1/4	4.4	0.172	25.4	1.00	14.27	0.562	5.6	0.22	17.32	0.682	14.96	0.589	—	—
1/2 x 3/8	7.5	0.297	25.4	1.00	14.27	0.562	5.6	0.22	17.32	0.682	14.96	0.589	—	—
5/8 x 1/4	4.4	0.172	26.2	1.03	17.53	0.690	5.8	0.23	20.24	0.797	17.91	0.705	—	—
5/8 x 3/8	7.5	0.297	26.2	1.03	17.53	0.690	5.8	0.23	20.24	0.797	17.91	0.705	—	—
3/4 x 1/4	4.4	0.172	27.7	1.09	20.98	0.826	6.9	0.27	24.69	0.972	22.35	0.880	10.4	0.41
3/4 x 3/8	7.5	0.297	27.7	1.09	20.98	0.826	6.9	0.27	24.69	0.972	22.35	0.880	—	—
3/4 x 1/2	10.0	0.391	30.2	1.19	20.98	0.826	6.9	0.27	24.69	0.972	22.35	0.880	—	—
1 x 3/4	15.5	0.609	37.3	1.47	27.46	1.081	7.1	0.28	31.04	1.222	28.70	1.130	—	—

[a] For dimensions shown on Figure 15 but not specified in above table, see corresponding dimensions for the specified outside diameter in Table 4.

6. Section 2—Flareless Tube Fittings. The flareless tube fittings shall be as shown in Figures 16 to 32 and Tables 8 to 12. The basic design of these fittings is derived from existing military standards.

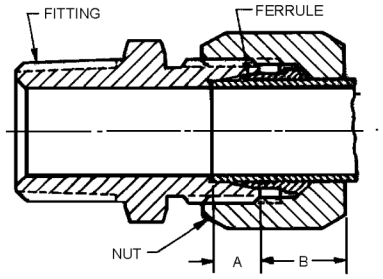


FIGURE 16A—ASSEMBLY WITH STYLE A FERRULE (FIGURE 28)

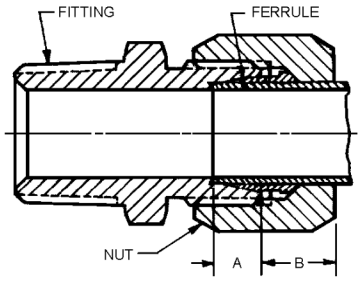


FIGURE 16B—ASSEMBLY WITH STYLE B FERRULE (FIGURE 29)

FIGURE 16—DETAILS OF FLARELESS HYDRAULIC TUBE FITTING ASSEMBLIES

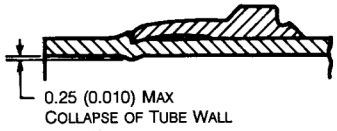


FIGURE 17—ENLARGED VIEW OF STYLE A FERRULE BITE

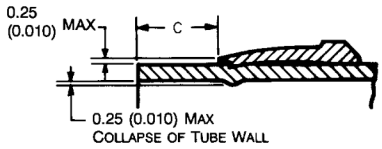


FIGURE 18—ENLARGED VIEW OF STYLE B FERRULE BITE

TABLE 8—DIMENSIONS OF FLARELESS HYDRAULIC TUBE FITTING ASSEMBLIES (FIGURES 16 AND 18)

Nominal Tube OD	A (Ref) mm	A (Ref) in	B (Ref) mm	B (Ref) in	C (Ref) mm	C (Ref) in
1/8	4.78	0.188	7.9	0.31	2.0	0.08
3/16	5.94	0.234	8.6	0.34	3.0	0.12
1/4	5.94	0.234	10.7	0.42	3.6	0.14
5/16	6.35	0.250	10.7	0.42	3.6	0.14
3/8	6.35	0.250	11.9	0.47	3.6	0.14
1/2	7.75	0.305	12.7	0.50	3.6	0.14
5/8	8.89	0.350	13.5	0.53	3.6	0.14
3/4	8.89	0.350	14.2	0.56	3.6	0.14
7/8	8.89	0.350	13.5	0.53	—	—
1	10.54	0.415	16.8	0.66	4.3	0.17
1-1/4	10.54	0.415	18.3	0.72	5.1	0.20
1-1/2	12.32	0.485	18.3	0.72	5.1	0.20
2	12.32	0.485	21.3	0.84	5.1	0.20

6.1 Assembly Instructions for Hydraulic Flareless Tube Fittings. These instructions apply to the assembly of hydraulic tube fittings of the flareless type given in Tables 9 to 12 and Figures 19 to 32.

The following instructions should be used to assure proper make-up of the fitting when assembled since the fitting depends on securing the ferrule to the tube by the cutting action of the ferrule into the tube.

6.1.1 Cut tube square and burr inside and outside corner (not excessive).

6.1.2 Assemble fitting by sliding nut over tubing with open end out. Slide ferrule on tubing with cutting edge out, the large head end should be inside of the nut. Lubricate the ferrule and the threads on the body and nut with oil or petrolatum. Insert tube into fitting.

6.1.3 Bottom the tube in the fitting, and tighten the nut until the ferrule just grips the tube. With a little experience, the mechanic can determine this point by feel. If the fittings are bench assembled, the gripping action can be determined by rotating the tube by hand as the nut is drawn down. When the tube can no longer be turned by hand, the ferrule has started to grip the tube.

6.1.4 After the ferrule grips the tube, tighten the nut one full turn. This may vary slightly with different tubing materials, but for general practice, it is a good rule for the mechanic to follow.

6.1.5 The fittings can now be disassembled for inspection. The two styles of ferrules differ somewhat in inspection even though their principles of makeup and application are similar.

a. For the ferrule in Figure 28, the bite or cut into the tube can be readily seen since it is on the lead edge of the ferrule. The bite into the tube should show a definite groove where the ferrule cuts into the tube and peels the metal over the lead edge of the ferrule. See Figure 17 for further detail.
b. For the ferrule in Figure 29, the pilot at the end of the ferrule should be contacting or be within 0.038 mm (0.0015 in) of the tube for hard material or not more than 0.13 mm (0.005 in) on soft material. See Figure 18 for further detail. This is an indication that the cutting edge has performed its function and has taken a secure bite in the tube. The sleeve should be slightly sprung or arched.

For both styles of ferrules, the rounded or lead edge should show a good seat in the fitting, and the head or shoulder end should be collapsed tight against the tube. The ferrules should have no end movement; however, the ferrule may be rotated on the tube due to spring back of the material. The performance of the fitting is not affected if the ferrule rotates.

6.1.6 In production, it may be preferable to use a threaded presetting tool to preform the ferrule onto the tubing. The presetting tool is a counterpart of the fitting hardened to provide good wearing properties for repeated usage. When using the presetting tool, the assembly instructions are the same, as the presetting tool takes the place of the fitting. Care should be taken to keep the cam surface of the presetting tool free of defects since they would transfer themselves to the ferrule, which would result in improper seating when the fitting is installed.

6.1.7 In some installations, it may be necessary to use a mandrel to support the inside of the tube when setting the ferrule. This is only necessary when the tube wall is so thin or so soft that it will not resist the biting action of the ferrule without collapsing. The mandrel in this instance supports the tube and allows the ferrule to bite into the tube without deforming or collapsing. Because the use of a mandrel allows very little give in the tubing, the setting of the ferrule may be made with slightly fewer turns than described previously.

6.2 Reassembly Instructions for Flareless Fittings. After disassembly of the fitting joint, the flareless fitting can be reassembled by assembling the tube and ferrule into the socket of the fitting and threading the nut onto the fitting.

The operation of assembly up to the point at which the ferrule seats itself in the fitting can usually be accomplished by hand or with the use of a small wrench. If a wrench is required, only low torques are necessary to seat the ferrule.

When the ferrule is seated, an increase in the torque will be quite evident. When this point is reached, draw the nut up approximately 1/6 of a turn minimum, but not more than 1/3 of a turn, to complete the tightening operation.

NOTE—Instructions for assembling adjustable and swivel style hydraulic fittings in straight thread O-ring bosses are given immediately following the table of dimensions of O-ring boss plugs.

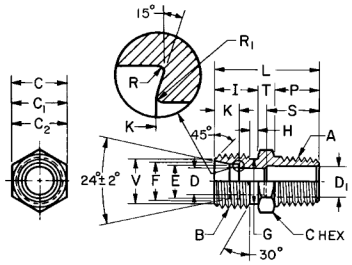


FIGURE 19A—MALE CONNECTOR (080102)

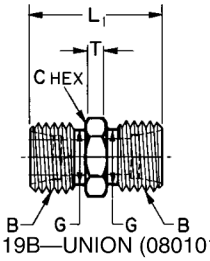


FIGURE 19B—UNION (080101)

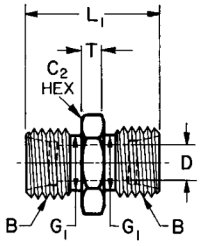


FIGURE 19C—LARGE HEX UNION* (080119)

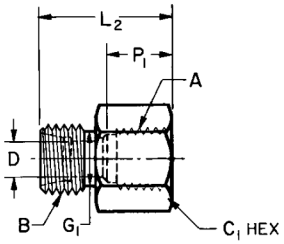


FIGURE 19D—FEMALE CONNECTOR (080103)

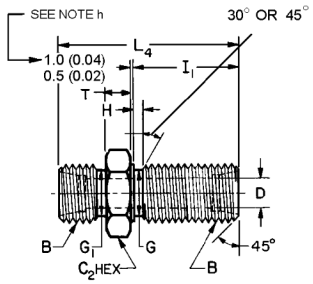


FIGURE 20A—BULKHEAD UNION (080601)

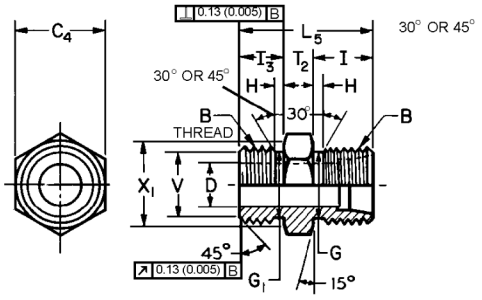


FIGURE 20B—STRAIGHT THREAD CONNECTOR SHORT* (080120)

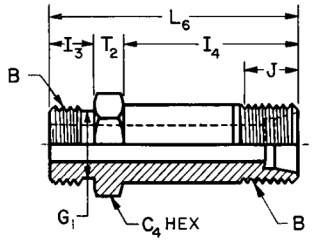


FIGURE 20C—STRAIGHT THREAD CONNECTOR LONG* (081720)

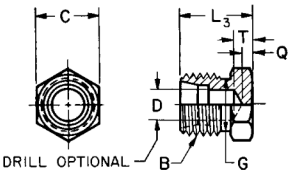


FIGURE 20D—PLUG (080109)

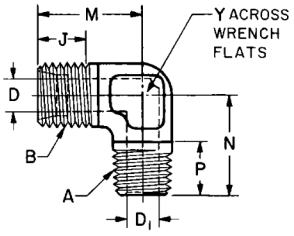


FIGURE 21A—90 DEGREE MALE ELBOW (080202)

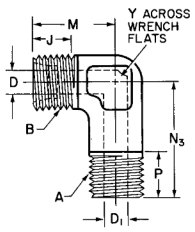


FIGURE 21B—90 DEGREE MALE LONG ELBOW (081502)

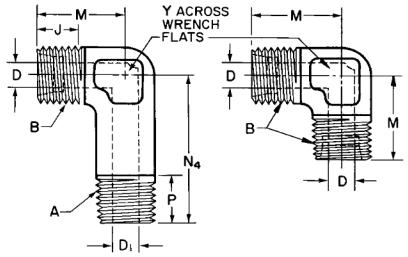


FIGURE 21C—90 DEGREE MALE EXTRA LONG ELBOW (081602)

FIGURE 21D—90 DEGREE UNION ELBOW (080201)

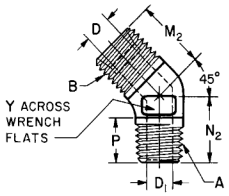


FIGURE 21E—45 DEGREE MALE ELBOW (080302)

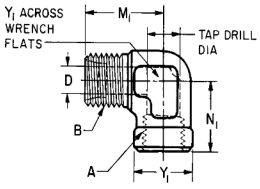


FIGURE 22A—90 DEGREE FEMALE ELBOW (080203)

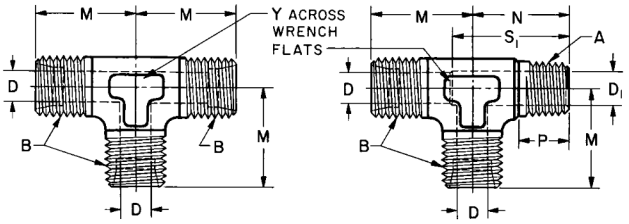


FIGURE 22B—UNION TEE (080401)

FIGURE 22C—MALE RUN TEE (080424)

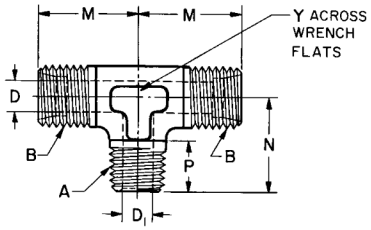


FIGURE 22D—MALE BRANCH TEE (080425)

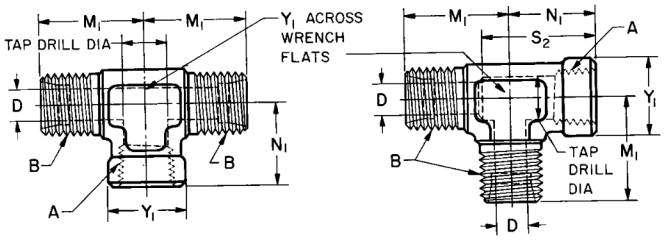


FIGURE 23A—FEMALE BRANCH TEE (080427)

FIGURE 23B—FEMALE RUN TEE (080426)

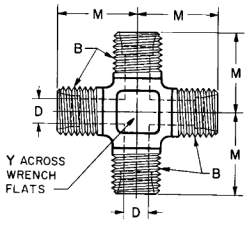


FIGURE 23—CROSS (080501)

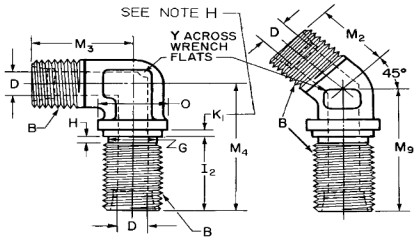


FIGURE 24A—90 DEGREE BULKHEAD ELBOW (080701)

FIGURE 24B—45 DEGREE BULKHEAD ELBOW (080801)

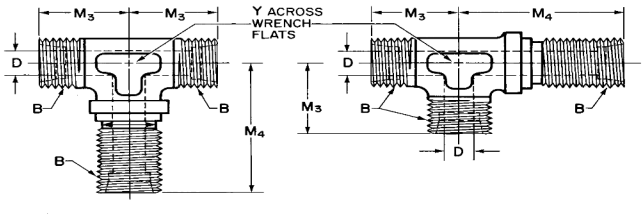


FIGURE 24C—BULKHEAD BRANCH TEE (080959)

FIGURE 24D—BULKHEAD RUN TEE (080958)

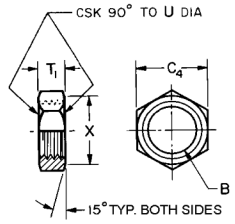


FIGURE 25A—STRAIGHT THREAD LOCKNUT* (080117)

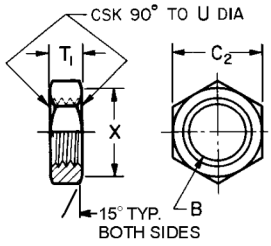


FIGURE 25B—BULKHEAD LOCKNUT (080118)

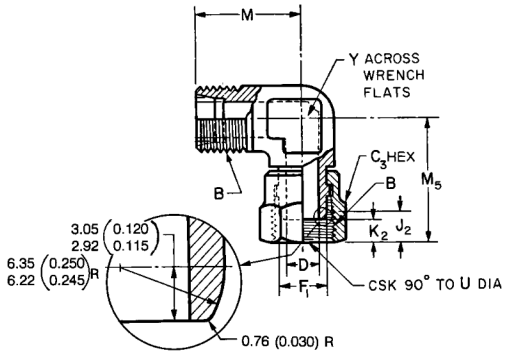


FIGURE 25C—90 DEGREE SWIVEL ELBOW (080221)

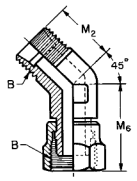


FIGURE 26A—45 DEGREE SWIVEL ELBOW (080321)

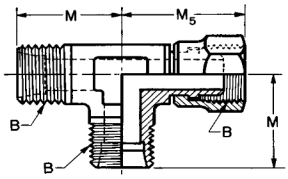


FIGURE 26B—SWIVEL RUN TEE (080432)

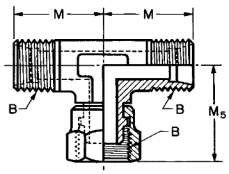


FIGURE 26C—SWIVEL BRANCH TEE (080433)

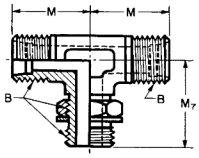


FIGURE 26D—STRAIGHT THREAD BRANCH TEE † (080429)

THE DESIGN AND METHOD OF ATTACHING THE SWIVEL NUT SHALL BE OPTIONAL WITH THE MANUFACTURER PROVIDING THE TABULATED DIMENSIONS ARE MAINTAINED AND THE NUT TURNS FREELY.

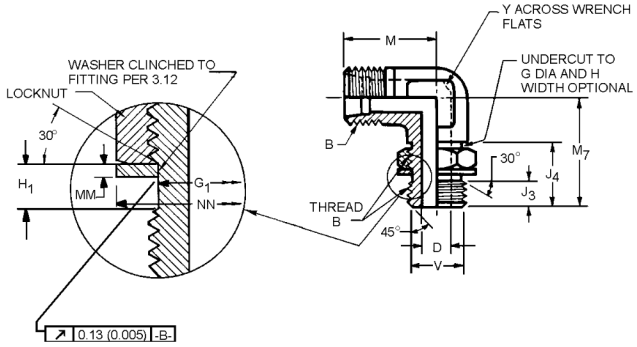


FIGURE 27A—90 DEGREE STRAIGHT THREAD ELBOW† (080220)

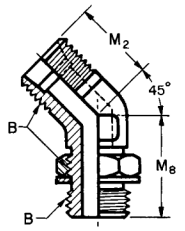


FIGURE 27B—45 DEGREE STRAIGHT THREAD ELBOW† (080320)

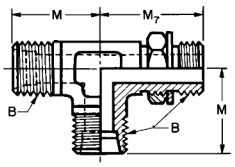


FIGURE 27C—STRAIGHT THREAD RUN TEE† (080428)

NOTE—UNSPECIFIED DETAIL WITH RESPECT TO DIMENSIONS, TOLERANCES, CONTOURS, MATERIAL, WORKMANSHIP, ETC., MUST CONFORM TO GENERAL SPECIFICATIONS FOR HYDRAULIC TUBE FITTINGS. THE DIMENSIONAL DESIGNATIONS FOR TUBE ENDS IN FIGURES 19A THRU 27C, FOR SWIVEL ENDS IN FIGURE 25C THRU 26C, FOR O-RING BOSS ENDS IN FIGURES 20B AND 20C, AND FOR ADJUSTABLE STRAIGHT THREAD ENDS IN FIGURES 26D THRU 27C SHALL APPLY TO CORRESONDING ENDS OF OTHER FIGURES ON THIS AND PRECEDING PAGE UNLESS SHOWN OTHERWISE. FIGURES 19A THRU 27C ON THIS AND PRECEDING PAGE APPLY TO TABLE 9. CODES SHOWN IN BRACKETS ADJACENT TO FIGURE NUMBERS REPRESENT RESPECTIVE FITTING IDENTIFICATION IN ACCORDANCE WITH SAE J846.

* MODIFICATION OF 1/8-1 IN SIZES IN THESE TYPES OF FITTINGS FOR USE WITH MM. 33649 (OR SUPERSEDED AND 10050) BOSSES IS SHOWN IN FIGURE 35 AND TABLE 15.

† IF DESIRED BY THE PURCHASER AND SO SPECIFIED, THESE FITTINGS MAY BE FURNISHED WITH LARGE HEXAGON LOCKNUT SHOWN IN FIGURE 25B.

TABLE 9—DIMENSIONS OF ALL BODIES AND LOCKNUTS (FIGURES 19A TO 27C)

Nom Tube OD, in	A Dryseal Pipe Thread, SAE J476 (ANSI B2.2)	B[f] Thread Size, in SAE J475 (ISO R725) Class 2A Ext Class 2B Int	C[g] Hex Nom, in	C_1[g] Hex Nom, in	C_2[g] Hex Nom, in	C_3[g] Hex Min, in	C_4[g] Hex Nom, in	D[l] Dia Drill mm	D[l] Dia Drill in	D[b][i] Dia Drill mm	D_1[b][i] Dia Drill in	E Dia mm +0.10 –0.00	E Dia in +0.004 –0.000	F Dia mm +0.10 –0.00	F Dia in +0.004 –0.000	F_1 Dia mm +0.13 –0.00	F_1 Dia in +0.005 –0.000
1/8	1/8-27	5/16-24	7/16	9/16	9/16	7/16	7/16	2.4	0.093	4.8	0.188	3.43	0.135	4.80	0.189	4.32	0.170
3/16	1/8-27	3/8-24	7/16	9/16	5/8	1/2	1/2	3.2	0.125	4.8	0.188	4.98	0.196	6.78	0.267	6.35	0.250
1/4	1/8-27	7/16-20	1/2	9/16	11/16	9/16	9/16	5.2	0.203	4.8	0.188	6.63	0.261	8.10	0.319	8.13	0.320
5/16	1/8-27	1/2-20	9/16	9/16	3/4	5/8	5/8	6.0	0.234	4.8	0.188	8.23	0.324	9.70	0.382	9.65	0.380
3/8	1/4-18	9/16-18	5/8	3/4	13/16	11/16	11/16	7.0	0.281	7.0	0.281	9.80	0.386	11.20	0.441	11.30	0.445
1/2	3/8-18	3/4-16	13/16	7/8	1	7/8	7/8	10.7	0.422	10.3	0.406	13.06	0.514	15.27	0.601	14.55	0.573
5/8	1/2-14	7/8-14	15/16	1-1/8	1-1/8	1	1	12.7	0.500	13.5	0.531	16.28	0.641	18.47	0.727	18.16	0.715
3/4	3/4-14	1-1/16-12	1-1/8	1-3/8	1-3/8	1-1/4	1-1/4	16.6	0.656	18.0	0.719	19.46	0.766	21.64	0.852	21.21	0.835
7/8	3/4-14	1-3/16-12	1-1/4	1-3/8	1-1/2	1-3/8	1-3/8	18.0	0.719	18.0	0.719	22.63	0.891	24.82	0.977	24.10	0.949
1	1- 11-1/2	1-5/16-12	1-3/8	1-5/8	1-5/8	1-1/2	1-1/2	22.2	0.875	23.8	0.938	25.81	1.016	27.99	1.102	26.92	1.060
1-1/4	1-1/4-11-1/2	1- 5/8-12	1-11/16	2	1-7/8	2	1-7/8	27.8	1.093	31.7	1.250	32.26	1.270	34.42	1.355	33.66	1.325
1-1/2	1-1/2-11-1/2	1- 7/8-12	2	2-3/8	2-1/8	2-1/4	2-1/8	34.1	1.344	38.0	1.500	38.61	1.520	40.74	1.604	40.39	1.590
2	2- 11-1/2	2- 1/2-12	2-5/8	2-7/8	2-3/4	2-7/8	2-3/4	46.0	1.813	49.0	1.938	51.36	2.022	53.54	2.108	53.21	2.095

Nom Tube OD, in	G Dia mm +0.05 –0.25	G Dia in +0.002 –0.010	G_1[a] Dia mm +0.05 –0.08	G_1[a] Dia in +0.002 –0.003	H mm +0.8 –0.0	H in +0.030 –0.000	H_1 mm +0.3 –0.0	H_1 in +0.010 –0.000	I mm ±0.4	I in ±0.016	I_1 mm ±0.05	I_1 in ±0.02	I_2 mm ±0.5	I_2 in ±0.02	I_3 mm ±0.13	I_3 in ±0.005	I_4 mm ±0.5	I_4 in ±0.02	J[k] Full Thread Min mm	J[k] Full Thread Min in
1/8	6.35	0.250	6.35	0.250	1.6	0.063	3.2	0.125	9.5	0.375	25.9	1.02	21.1	0.83	7.54	0.297	27.4	1.08	9.1	0.360
3/16	7.95	0.313	7.95	0.313	1.6	0.063	3.3	0.131	10.7	0.422	26.9	1.06	22.4	0.88	7.54	0.297	30.2	1.19	10.3	0.407
1/4	9.25	0.364	9.25	0.364	1.9	0.075	4.0	0.156	11.5	0.453	28.4	1.12	23.9	0.94	9.14	0.360	33.8	1.33	11.1	0.438
5/16	10.85	0.427	10.85	0.427	1.9	0.075	4.0	0.156	11.5	0.453	28.4	1.12	23.9	0.94	9.14	0.360	35.3	1.39	11.1	0.438
3/8	12.24	0.482	12.24	0.482	2.1	0.083	4.0	0.156	11.9	0.469	29.7	1.17	24.9	0.98	9.93	0.391	37.6	1.48	11.5	0.454
1/2	16.76	0.660	16.76	0.660	2.4	0.094	4.7	0.187	14.3	0.562	33.3	1.31	28.4	1.12	11.13	0.438	45.7	1.80	13.9	0.547
5/8	19.63	0.773	19.63	0.773	2.7	0.107	5.6	0.219	15.9	0.625	36.8	1.45	32.3	1.27	12.70	0.500	51.6	2.03	15.5	0.610
3/4	24.00	0.945	24.00	0.945	3.2	0.125	5.9	0.234	17.5	0.688	39.6	1.56	35.1	1.38	15.09	0.594	61.5	2.42	17.1	0.673
7/8	27.18	1.070	27.18	1.070	3.2	0.125	5.9	0.234	17.5	0.688	39.6	1.56	35.1	1.38	15.09	0.594	66.3	2.61	17.1	0.673
1	30.35	1.195	30.35	1.195	3.2	0.125	5.9	0.234	17.5	0.688	39.6	1.56	35.1	1.38	15.09	0.594	70.4	2.77	17.1	0.673
1-1/4	38.28	1.507	38.28	1.507	3.2	0.125	5.9	0.234	17.5	0.688	39.6	1.56	35.1	1.38	15.09	0.594	86.1	3.39	17.1	0.673
1-1/2	44.60	1.756	44.60	1.756	3.2	0.125	5.9	0.234	17.5	0.688	39.6	1.56	35.1	1.38	15.09	0.594	96.8	3.81	17.1	0.673
2	60.48	2.381	60.48	2.381	3.2	0.125	5.9	0.234	17.5	0.688	45.0	1.77	40.1	1.58	15.09	0.594	121.4	4.78	17.1	0.673

Continued on next page

TABLE 9—DIMENSIONS OF ALL BODIES AND LOCKNUTS (FIGURES 19A TO 27C) (CONTINUED)

Nom Tube OD, in	J_2 Full Thread Min mm	J_2 Full Thread Min in	J_3 Full Thread mm ±0.13	J_3 Full Thread in ±0.005	J_4 mm min	J_4 in min	K mm +0.40 −0.13	K in +0.016 −0.005	K_1[h] mm ±0.5	K_1[h] in ±0.02	K_2 mm +1.0 −0.5	K_2 in +0.04 −0.02	L mm ±0.5	L in ±0.02	L_1 mm ±0.5	L_1 in ±0.02	L_2 mm ±0.5	L_2 in ±0.02	L_3 mm ±0.5	L_3 in ±0.02
1/8	7.5	0.297	5.94	0.234	15.0	0.59	4.78	0.188	2.4	0.094	4.4	0.172	26.4	1.04	25.9	1.02	26.7	1.05	16.0	0.63
3/16	7.5	0.297	5.94	0.234	15.0	0.59	5.94	0.234	2.4	0.094	4.5	0.178	27.7	1.09	28.2	1.11	27.4	1.08	17.3	0.68
1/4	7.6	0.300	6.73	0.265	18.5	0.73	5.94	0.234	2.4	0.094	5.6	0.219	28.4	1.12	30.0	1.18	27.7	1.09	18.0	0.71
5/16	8.4	0.331	6.73	0.265	18.5	0.73	6.35	0.250	2.4	0.094	5.6	0.219	28.4	1.12	30.0	1.18	27.4	1.08	18.0	0.71
3/8	8.5	0.333	7.92	0.312	19.1	0.75	6.35	0.250	2.4	0.094	6.7	0.265	34.0	1.34	31.5	1.24	33.3	1.31	19.0	0.75
1/2	9.5	0.375	8.74	0.344	21.9	0.86	7.75	0.305	3.2	0.125	6.4	0.250	36.6	1.44	36.1	1.42	37.3	1.47	21.6	0.85
5/8	11.7	0.461	9.93	0.391	25.4	1.00	8.89	0.350	3.2	0.125	7.7	0.304	44.4	1.75	40.9	1.61	44.7	1.76	24.6	0.97
3/4	11.9	0.469	11.91	0.469	29.0	1.14	8.89	0.350	3.2	0.125	9.0	0.354	47.8	1.88	46.0	1.81	48.0	1.89	27.9	1.10
7/8	11.9	0.469	11.91	0.469	29.0	1.14	8.89	0.350	3.2	0.125	7.1	0.281	47.8	1.88	46.0	1.81	47.2	1.86	27.9	1.10
1	11.1	0.438	11.91	0.469	29.0	1.14	10.54	0.415	3.2	0.125	6.4	0.250	52.6	2.07	46.0	1.81	54.1	2.13	27.9	1.10
1-1/4	11.1	0.438	11.91	0.469	29.0	1.14	10.54	0.415	3.2	0.125	6.7	0.265	55.4	2.18	48.0	1.89	56.4	2.22	30.0	1.18
1-1/2	11.1	0.438	11.91	0.469	29.0	1.14	12.32	0.485	3.2	0.125	7.3	0.289	57.9	2.28	49.8	1.96	56.6	2.23	31.8	1.25
2	11.1	0.438	11.91	0.469	29.0	1.14	12.32	0.485	3.2	0.125	7.1	0.281	62.5	2.46	53.6	2.11	58.7	2.31	35.6	1.40

Nom Tube OD, in	L_4 mm ±0.5	L_4 in ±0.02	L_5 mm ±0.5	L_5 in ±0.02	L_6 mm ±0.5	L_6 in ±0.02	M mm ±0.8	M in ±0.03	M_1 mm ±0.8	M_1 in ±0.03	M_2 mm ±0.8	M_2 in ±0.03	M_3 mm ±0.8	M_3 in ±0.03	M_4 mm ±0.8	M_4 in ±0.03	M_5 mm ±1.5	M_5 in ±0.06	M_6 mm ±1	M_6 in ±0.06
1/8	43.4	1.71	25.1	0.99	43.2	1.70	19.6	0.77	21.1	0.83	16.3	0.64	20.3	0.80	34.5	1.36	24.9	0.98	24	0.95
3/16	45.7	1.80	26.4	1.04	46.0	1.81	21.1	0.83	21.1	0.83	16.3	0.64	23.9	0.94	36.6	1.44	25.9	1.02	24	0.95
1/4	48.0	1.89	28.7	1.13	51.3	2.02	22.6	0.89	22.6	0.89	17.8	0.70	24.1	0.95	38.6	1.52	26.7	1.05	24	0.98
5/16	48.0	1.89	28.7	1.13	52.8	2.08	24.1	0.95	24.1	0.95	19.1	0.75	26.7	1.05	42.2	1.66	29.0	1.14	26	1.05
3/8	50.3	1.98	30.7	1.21	56.6	2.23	26.7	1.05	26.7	1.05	21.1	0.83	27.4	1.08	43.2	1.70	32.5	1.28	30	1.20
1/2	56.4	2.22	35.1	1.38	66.5	2.62	31.8	1.25	31.2	1.23	24.9	0.98	33.8	1.33	50.0	1.97	37.3	1.47	33	1.33
5/8	63.0	2.48	39.9	1.57	75.7	2.98	36.1	1.42	36.1	1.42	27.4	1.08	38.6	1.52	57.7	2.27	40.9	1.61	37	1.48
3/4	69.1	2.72	45.5	1.79	89.7	3.53	40.1	1.58	40.1	1.58	32.3	1.27	41.7	1.64	63.0	2.48	45.0	1.77	40	1.61
7/8	69.1	2.72	45.5	1.79	94.5	3.72	42.2	1.66	41.1	1.62	34.0	1.34	43.2	1.70	64.8	2.55	45.7	1.80	40	1.58
1	69.1	2.72	46.2	1.82	99.3	3.91	43.9	1.73	43.9	1.73	34.5	1.36	43.9	1.73	66.3	2.61	47.2	1.86	43	1.70
1-1/4	71.1	2.80	48.3	1.90	117.1	4.61	48.0	1.89	52.8	2.08	36.8	1.45	51.3	2.02	73.4	2.89	52.8	2.08	45	1.80
1-1/2	72.9	2.87	50.0	1.97	129.5	5.10	51.3	2.02	65.5	2.58	38.6	1.52	55.9	2.20	80.5	3.17	55.9	2.20	48	1.92
2	82.0	3.23	54.1	2.13	158.2	6.23	62.2	2.45	67.1	2.64	46.5	1.83	60.7	2.39	95.8	3.77	64.0	2.52	52	2.05

Nom Tube OD, in	M_7 mm ±0.8	M_7 in ±0.03	M_8 mm ±0.8	M_8 in ±0.03	M_9 mm ±0.8	M_9 in ±0.03	N mm ±0.8	N in ±0.03	N_1 mm ±0.8	N_1 in ±0.03	N_2 mm ±0.8	N_2 in ±0.03	N_3 mm ±0.8	N_3 in ±0.03	N_4 mm ±0.8	N_4 in ±0.03	O mm ±0.5	O in ±0.02	P Min	P Min
1/8	23.1	0.91	22.4	0.88	32.5	1.28	18.3	0.72	16.8	0.66	13.2	0.52	25.4	1.00	32.5	1.28	11.1	0.438	9.7	0.38
3/16	23.9	0.94	22.4	0.88	33.8	1.33	18.3	0.72	16.8	0.66	13.2	0.52	26.4	1.04	34.3	1.35	12.7	0.500	9.7	0.38
1/4	26.2	1.03	26.7	1.05	36.8	1.45	19.8	0.78	16.8	0.66	16.3	0.64	29.7	1.17	39.6	1.56	14.3	0.562	9.7	0.38
5/16	28.7	1.13	26.7	1.05	36.8	1.45	20.6	0.81	16.8	0.66	16.3	0.64	29.7	1.17	41.4	1.63	15.9	0.625	9.7	0.38
3/8	31.8	1.25	29.0	1.14	39.6	1.56	27.7	1.09	22.4	0.88	21.8	0.86	40.1	1.58	52.6	2.07	17.5	0.688	14.2	0.56
1/2	36.8	1.45	33.0	1.30	46.0	1.81	31.0	1.22	25.9	1.02	24.1	0.95	46.2	1.82	61.5	2.42	22.2	0.875	14.2	0.56
5/8	43.2	1.70	38.6	1.52	52.1	2.05	37.3	1.47	31.2	1.23	29.7	1.17	55.1	2.17	72.9	2.87	25.4	1.000	19.0	0.75
3/4	49.3	1.94	43.9	1.73	57.2	2.25	40.4	1.59	34.5	1.36	30.5	1.20	62.0	2.44	83.3	3.28	30.2	1.188	19.0	0.75
7/8	50.8	2.00	45.7	1.80	58.7	2.31	42.9	1.69	36.1	1.42	33.0	1.30	65.8	2.59	88.9	3.50	33.3	1.312	19.0	0.75
1	52.1	2.05	47.2	1.86	60.5	2.38	50.0	1.97	41.1	1.62	37.6	1.48	76.5	3.01	102.9	4.05	36.5	1.438	23.9	0.94
1-1/4	57.2	2.25	48.5	1.91	61.2	2.41	60.5	2.38	43.2	1.70	42.4	1.67	93.7	3.69	127.0	5.00	44.4	1.750	24.6	0.97
1-1/2	60.7	2.39	48.5	1.91	61.5	2.42	67.1	2.64	52.8	2.08	45.0	1.77	104.1	4.10	141.0	5.55	50.8	2.000	25.4	1.00
2	73.4	2.89	47.2	1.86	65.5	2.58	76.2	3.00	60.7	2.39	53.6	2.11	122.2	4.81	168.4	6.63	66.7	2.625	26.2	1.03

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TABLE 9—DIMENSIONS OF ALL BODIES AND LOCKNUTS (FIGURES 19A TO 27C) (CONTINUED)

Nom Tube OD, in	P_1 Max mm	P_1 Max in	Q Min mm	Q Min in	R Rad Max mm	R Rad Max in	R_1 Rad Max mm	R_1 Rad Max in	S[b] Max mm	S[b] Max in	S_1[b][c] Min mm	S_1[b][c] Min in	S_2[c] Min mm	S_2[c] Min in	T[d] Ref mm	T[d] Ref in	T_1 mm ±0.5	T_1 in ±0.02	T_2[d] Ref mm	T_2[d] Ref in
1/8	11.7	0.46	2.8	0.11	0.3	0.010	0.1	0.005	12.4	0.49	20.6	0.81	19.0	0.75	5.6	0.22	5.6	0.22	7.1	0.28
3/16	11.7	0.46	2.8	0.11	0.4	0.016	0.1	0.005	12.4	0.49	20.8	0.82	19.3	0.76	5.6	0.22	5.6	0.22	7.1	0.28
1/4	11.7	0.46	2.8	0.11	0.4	0.016	0.1	0.005	14.0	0.55	27.2	1.07	20.3	0.80	5.6	0.22	7.1	0.28	7.1	0.28
5/16	11.7	0.46	3.0	0.12	0.4	0.016	0.3	0.010	14.0	0.55	28.2	1.11	20.8	0.82	5.6	0.22	7.1	0.28	7.1	0.28
3/8	17.0	0.67	3.0	0.12	0.4	0.016	0.3	0.010	—	—	—	—	26.9	1.06	6.4	0.25	6.9	0.27	7.9	0.31
1/2	17.3	0.68	4.0	0.16	0.4	0.016	0.3	0.010	17.0	0.67	38.1	1.50	32.3	1.27	6.4	0.25	7.9	0.31	8.6	0.34
5/8	22.9	0.90	4.0	0.16	0.4	0.016	0.3	0.010	23.1	0.91	44.7	1.76	38.6	1.52	7.9	0.31	9.1	0.36	10.2	0.40
3/4	23.1	0.91	4.8	0.19	0.4	0.016	0.3	0.010	23.9	0.94	49.5	1.95	43.9	1.73	9.7	0.38	10.4	0.41	11.9	0.47
7/8	23.1	0.91	4.8	0.19	0.4	0.016	0.3	0.010	—	—	—	—	46.2	1.82	9.7	0.38	10.4	0.41	11.9	0.47
1	29.0	1.14	4.8	0.19	0.4	0.016	0.3	0.010	28.7	1.13	62.2	2.45	53.3	2.10	9.7	0.38	10.4	0.41	12.7	0.50
1-1/4	29.5	1.16	5.8	0.23	0.6	0.025	0.4	0.016	30.5	1.20	75.7	2.98	58.2	2.29	11.7	0.46	10.4	0.41	14.7	0.58
1-1/2	29.5	1.16	5.8	0.23	0.6	0.025	0.4	0.016	32.3	1.27	85.3	3.36	71.1	2.80	13.5	0.53	10.4	0.41	16.5	0.65
2	30.0	1.18	8.4	0.33	0.6	0.025	0.4	0.016	34.8	1.37	100.3	3.95	84.8	3.34	17.3	0.68	10.4	0.41	20.6	0.81

Nom Tube OD, in	U Dia mm +0.4 –0.0	U Dia in +0.016 –0.000	V Dia mm ±0.25	V Dia in ±0.010	X Dia mm ±0.13	X Dia in ±0.005	X_1 Dia mm ±0.13	X_1 Dia in ±0.005	Y[m] mm +0.0	Y[m] in +0.000	Y_1[e] mm +0.0	Y_1[e] in +0.000	MM mm ±0.08	MM in ±0.003	NN Dia mm ±0.4	NN Dia in ±0.016
1/8	8.1	0.317	6.25	0.245	14.27	0.562	11.13	0.438	11.1-0.8	0.438-0.030	14.3-0.8	0.562-0.030	0.76	0.030	12.8	0.504
3/16	9.7	0.380	7.75	0.305	15.88	0.625	12.70	0.500	11.1-0.8	0.438-0.030	14.3-0.8	0.562-0.030	0.76	0.030	14.6	0.575
1/4	11.3	0.443	9.15	0.360	17.48	0.688	14.30	0.563	11.1-0.8	0.438-0.030	14.3-0.8	0.562-0.030	0.89	0.035	16.5	0.650
5/16	12.8	0.505	10.65	0.420	19.05	0.750	15.88	0.625	14.3-0.8	0.562-0.030	14.3-0.8	0.562-0.030	0.89	0.035	18.3	0.722
3/8	14.4	0.567	12.05	0.475	20.62	0.812	17.48	0.688	14.3-0.8	0.562-0.030	19.0-0.8	0.750-0.030	0.89	0.035	20.2	0.794
1/2	19.2	0.755	16.65	0.655	25.40	1.000	22.22	0.875	19.0-0.8	0.750-0.030	22.2-0.8	0.875-0.030	1.04	0.041	25.7	1.010
5/8	22.4	0.880	19.55	0.770	28.58	1.125	25.40	1.000	22.2-0.8	0.875-0.030	27.0-0.8	1.062-0.030	1.27	0.050	29.3	1.155
3/4	27.1	1.067	23.90	0.940	34.92	1.375	31.75	1.250	27.0-1.0	1.062-0.040	33.3-1.0	1.312-0.040	1.27	0.050	36.7	1.444
7/8	30.3	1.193	27.05	1.065	38.10	1.500	34.92	1.375	33.3-1.0	1.312-0.040	33.3-1.0	1.312-0.040	1.27	0.050	40.4	1.589
1	33.5	1.317	30.25	1.190	41.28	1.625	38.10	1.500	33.3-1.0	1.312-0.040	41.3-1.0	1.625-0.040	1.27	0.050	44.0	1.732
1-1/4	41.4	1.630	38.10	1.500	47.62	1.875	47.62	1.875	41.3-1.0	1.625-0.040	47.6-1.0	1.875-0.040	1.27	0.050	55.0	2.165
1-1/2	47.8	1.880	44.45	1.750	53.98	2.125	53.98	2.125	47.6-1.0	1.875-0.040	65.1-1.0	2.562-0.040	1.27	0.050	62.3	2.454
2	63.6	2.505	60.35	2.375	69.85	2.750	69.85	2.750	63.5-1.0	2.500-0.040	71.4-1.0	2.812-0.040	1.27	0.050	80.3	3.160

(a) O-ring groove undercut must be smooth and free from tool marks.
(b) At manufacturer's option, through passages in Figures 19A and 22C may conform with the smaller diameter specified or the appropriate end may be counterbored to the larger diameter for depths S and S1, respectively.
(c) Maximum depth shall be optional with manufacturer providing wall thickness is controlled in compliance with General Specifications.
(d) Minimum design thickness, not subject to inspection.
(e) The basic dimensions shall apply as minimum for boss diameters.
(f) Unified class 2B thread shall apply to swivel nuts Figures 25C, 26A, 26B, and 26C and with minor diameter modified to class 3B limits for locknuts Figures 25A and 25B.
(g) Across flat widths must fit standard wrench openings. See ANSI B18.2.2.
(h) Diameter of bulkhead pilot is the same as major thread diameter. Recommended pilot hole for bulkhead fittings is 0.4 mm (0.016 in) over major thread diameter.
(k) J full thread minimum with thread runout. If undercut to G diameter and H width. Length of thread and undercut must not be less than i.
(l) See Table 1A for tolerance.
(m) For optional metric fitting flats see Appendix A.

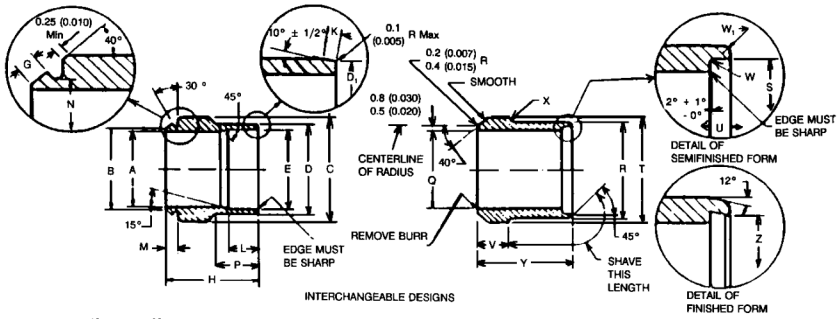


FIGURE 28—STYLE A FERRULE (080115A) FIGURE 29—STYLE B FERRULE (080115B)

NOTE—FIGURES 28 AND 29 APPLY TO TABLE 10. CODES SHOWN IN BRACKETS ADJACENT TO FIGURE NUMBERS REPRESENT RESPECTIVE FITTING IDENTIFICATiON IN ACCORDANCE WITH SAE J846.

TABLE 10—DIMENSIONS OF FERRULES (FIGURES 28 AND 29)

Nom Tube OD, in	A[a] Dia mm +0.08 −0.00	A[a] Dia in +0.003 −0.000	B Dia mm +0.00 −0.20	B Dia in +0.000 −0.008	C[a] Dia mm +0.13 −0.00	C[a] Dia in +0.005 −0.000	D[a] Dia mm +0.00 −0.08	D[a] Dia in +0.000 −0.003	D_1 Dia Ref mm	D_1 Dia Ref in	E[a] Dia mm +0.08 −0.00	E[a] Dia in +0.003 −0.000	G Ref mm	G Ref in	H mm ±0.08	H in ±0.003
1/8	3.30	0.130	3.81	0.150	6.02	0.237	4.52	0.178	4.3	0.171	3.56	0.140	0.69	0.027	7.32	0.288
3/16	4.90	0.193	5.38	0.212	7.80	0.307	6.32	0.249	6.1	0.242	5.21	0.205	0.69	0.027	8.36	0.329
1/4	6.48	0.255	6.98	0.275	9.32	0.367	7.92	0.312	7.7	0.303	6.81	0.268	0.69	0.027	9.22	0.363
5/16	8.08	0.318	8.59	0.338	10.92	0.430	9.52	0.375	9.3	0.366	8.38	0.330	0.69	0.027	9.32	0.367
3/8	9.65	0.380	10.16	0.400	12.50	0.492	11.18	0.440	10.9	0.431	9.98	0.393	0.74	0.029	9.98	0.393
1/2	12.83	0.505	13.59	0.535	16.84	0.663	14.91	0.587	14.7	0.577	13.23	0.521	1.12	0.044	10.90	0.429
5/8	16.03	0.631	16.79	0.661	19.81	0.780	18.11	0.713	17.9	0.703	16.43	0.647	1.07	0.042	11.23	0.442
3/4	19.20	0.756	19.96	0.786	23.50	0.925	21.29	0.838	21.0	0.828	19.61	0.772	1.27	0.050	12.06	0.475
7/8	22.38	0.881	23.14	0.911	27.00	1.063	24.46	0.963	24.2	0.953	22.78	0.897	1.32	0.052	12.06	0.475
1	25.55	1.006	26.31	1.036	30.15	1.187	27.64	1.088	27.4	1.078	25.96	1.022	1.37	0.054	12.06	0.475
1-1/4	32.00	1.260	32.74	1.289	36.73	1.446	32.06	1.341	33.8	1.331	32.38	1.275	1.57	0.062	12.06	0.475
1-1/2	38.35	1.510	39.09	1.539	43.03	1.694	40.39	1.590	40.1	1.580	38.71	1.524	1.57	0.062	12.06	0.475
2	51.16	2.014	51.79	2.039	56.13	2.210	53.19	2.094	52.9	2.084	51.46	2.026	1.78	0.070	12.93	0.509

Nom Tube OD, in	K mm +0.08 −0.05	K in +0.003 −0.002	L mm +0.40 −0.00	L in +0.016 −0.000	M mm +0.00 −0.15	M in +0.000 −0.006	N Dia mm +0.00 −0.13	N Dia in +0.000 −0.005	P Min mm	P Min in	P Max mm	P Max in	Q[b] Dia mm +0.08 −0.00	Q[b] Dia in +0.003 −0.000	R[b] Dia Min mm	R[b] Dia Min in
1/8	0.51	0.020	1.98	0.078	1.17	0.046	3.86	0.152	3.18	0.125	3.30	0.130	3.28	0.129	4.44	0.175
3/16	0.51	0.020	1.98	0.078	1.19	0.047	5.54	0.218	3.18	0.125	3.30	0.130	4.83	0.190	6.40	0.252
1/4	0.64	0.025	2.77	0.109	1.24	0.049	7.24	0.285	3.96	0.156	4.09	0.161	6.48	0.255	7.85	0.309
5/16	0.64	0.025	3.18	0.125	1.24	0.049	8.94	0.352	4.22	0.166	4.34	0.171	8.08	0.318	9.47	0.373
3/8	0.64	0.025	3.18	0.125	1.24	0.049	10.62	0.418	3.84	0.151	3.96	0.156	9.65	0.380	10.95	0.431
1/2	0.76	0.030	4.11	0.162	1.73	0.068	14.10	0.555	6.10	0.240	6.60	0.260	12.85	0.506	14.86	0.585
5/8	0.76	0.030	4.60	0.181	1.63	0.064	17.30	0.681	5.77	0.227	6.27	0.247	16.08	0.633	17.73	0.698
3/4	0.76	0.030	4.60	0.181	1.93	0.076	20.50	0.807	6.35	0.250	6.86	0.270	19.25	0.758	21.23	0.836
7/8	0.76	0.030	4.60	0.181	2.11	0.083	23.65	0.931	6.48	0.255	6.98	0.275	22.43	0.883	24.41	0.961
1	0.76	0.030	4.75	0.187	2.11	0.083	26.82	1.056	6.20	0.244	6.71	0.264	25.60	1.008	27.58	1.086
1-1/4	0.76	0.030	4.75	0.187	2.11	0.083	33.25	1.309	5.72	0.225	6.22	0.245	32.00	1.260	34.01	1.339
1-1/2	0.76	0.030	4.75	0.187	2.18	0.086	39.60	1.559	5.72	0.225	6.22	0.245	38.38	1.511	40.36	1.589
2	0.76	0.030	4.75	0.187	2.34	0.092	52.30	2.059	6.05	0.238	6.55	0.258	51.16	2.014	53.14	2.092

Continued on next page.

TABLE 10—DIMENSIONS OF FERRULES (FIGURES 28 AND 29) (CONTINUED)

Nom tube OD, in	R[b] Dia Max mm	R[b] Dia Max in	S[b] Dia Min mm	S[b] Dia Min in	S[b] Dia Max mm	S[b] Dia Max in	T[b] Dia mm ±0.13	T[b] Dia in ±0.005	U Min mm	U Min in	U Max mm	U Max in	V Min mm	V Min in	V Max mm	V Max in
1/8	4.52	0.178	3.91	0.154	4.06	0.160	5.16	0.203	0.38	0.015	0.58	0.023	1.98	0.078	2.13	0.084
3/16	6.50	0.256	5.77	0.227	5.92	0.233	7.93	0.312	0.51	0.020	0.71	0.028	1.98	0.078	2.13	0.084
1/4	7.95	0.313	7.26	0.286	7.42	0.292	9.12	0.359	0.61	0.024	0.81	0.032	2.44	0.096	2.59	0.102
5/16	9.58	0.377	8.89	0.350	9.04	0.356	10.72	0.422	0.61	0.024	0.81	0.032	2.44	0.096	2.59	0.102
3/8	11.05	0.435	10.36	0.408	10.52	0.414	12.29	0.484	0.61	0.024	0.81	0.032	2.95	0.116	3.10	0.122
1/2	14.96	0.589	14.12	0.556	14.27	0.562	15.88	0.625	0.61	0.024	0.81	0.032	2.95	0.116	3.10	0.122
5/8	17.83	0.702	16.99	0.669	17.14	0.675	19.05	0.750	0.61	0.024	0.81	0.032	2.95	0.116	3.10	0.122
3/4	21.34	0.840	20.50	0.807	20.65	0.813	22.23	0.875	0.61	0.024	0.81	0.032	2.95	0.116	3.10	0.122
7/8	24.51	0.965	23.67	0.932	23.83	0.938	25.40	1.000	0.61	0.024	0.81	0.032	2.95	0.116	3.10	0.122
1	27.69	1.090	26.85	1.057	27.00	1.063	28.58	1.125	0.61	0.024	0.81	0.032	2.95	0.116	3.10	0.122
1-1/4	34.11	1.343	33.27	1.310	33.43	1.316	35.71	1.406	0.61	0.024	0.81	0.032	2.95	0.116	3.10	0.122
1-1/2	40.46	1.593	39.62	1.560	39.78	1.566	42.06	1.656	0.61	0.024	0.81	0.032	2.95	0.116	3.10	0.122
2	53.24	2.096	52.40	2.063	52.55	2.069	55.58	2.188	0.61	0.024	0.81	0.032	3.89	0.153	4.04	0.159

Nom Tube OD, in	W Rad Min mm	W Rad Min in	W Rad Max mm	W Rad Max in	W_1 Rad mm	W_1 Rd in	X Rad mm	X Rad in	Y Min mm	Y Min in	Y Max mm	Y Max in	Z Dia Min mm	Z Dia Min in	Z Dia Max mm	Z Dia Max in
1/8	0.08	0.003	0.15	0.006	0.2	0.007	0.3	0.010	6.98	0.275	7.14	0.281	3.76	0.148	3.96	0.156
3/16	0.08	0.003	0.15	0.006	0.2	0.007	0.5	0.020	6.98	0.275	7.14	0.281	5.61	0.221	5.82	0.229
1/4	0.08	0.003	0.15	0.006	0.2	0.007	0.5	0.020	8.46	0.333	8.61	0.339	7.11	0.280	7.32	0.288
5/16	0.08	0.003	0.15	0.006	0.2	0.007	0.5	0.020	8.46	0.333	8.61	0.339	8.74	0.344	8.94	0.352
3/8	0.08	0.003	0.15	0.006	0.2	0.007	0.5	0.020	9.45	0.372	9.60	0.378	10.21	0.402	10.41	0.410
1/2	0.20	0.008	0.36	0.014	0.3	0.010	0.5	0.020	9.45	0.372	9.60	0.378	13.97	0.550	14.17	0.558
5/8	0.20	0.008	0.36	0.014	0.3	0.010	0.5	0.020	10.46	0.412	10.62	0.418	16.84	0.663	17.04	0.671
3/4	0.20	0.008	0.36	0.014	0.3	0.010	0.5	0.020	10.46	0.412	10.62	0.418	20.35	0.801	20.55	0.809
7/8	0.20	0.008	0.36	0.014	0.3	0.010	0.5	0.020	10.46	0.412	10.62	0.418	23.52	0.926	23.72	0.934
1	0.20	0.008	0.36	0.014	0.3	0.010	0.5	0.020	10.46	0.412	10.62	0.418	26.70	1.051	26.90	1.059
1-1/4	0.20	0.008	0.36	0.014	0.3	0.010	0.5	0.020	10.46	0.412	10.62	0.418	33.12	1.304	33.32	1.312
1-1/2	0.20	0.008	0.36	0.014	0.3	0.010	0.5	0.020	10.46	0.412	10.62	0.418	39.47	1.554	39.67	1.562
2	0.20	0.008	0.36	0.014	0.3	0.010	0.5	0.020	11.43	0.450	11.58	0.456	52.25	2.057	52.45	2.065

[a] These diameters, A, C, D, and E must be concentric with 0.13 mm (0.005 in).
[b] These diameters, Q, R, S, and T must be concentric wiht 0.13 mm (0.005 in).

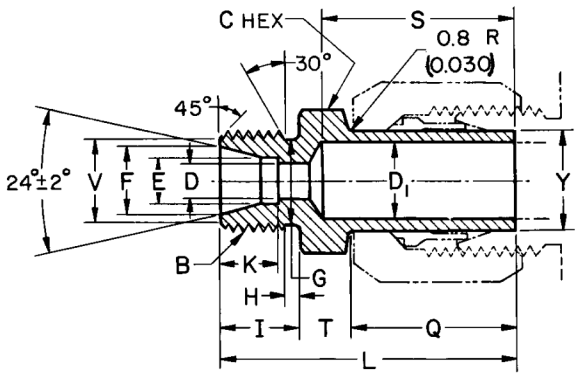


FIGURE 30—REDUCER WITHOUT LARGE END NUT AND FERRULE (080123)

TABLE 11—DIMENSIONS[a] OF REDUCERS (FIGURE 30)

Tube Reduction in	B Thread Size, in SAE J475 (ISO R725) Class 2A Ext	C Hex Nom, in	D[c] Dia Drill mm	D[c] Dia Drill in	D_1[c] Dia Drill mm	D_1[c] Dia Drill in	L mm ±0.5	L in ±0.02	Q mm ±0.5	Q in ±0.02	S mm ±0.5	S in ±0.02	T[b] Ref mm	T[b] Ref in	Y Dia mm ±0.08	Y Dia in ±0.003
3/8 x 1/4	7/16-20	1/2	5.2	0.203	6.3	0.250	40.9	1.61	22.4	0.88	23.4	0.92	5.6	0.22	9.52	0.375
1/2 x 1/4	7/16-20	9/16	5.2	0.203	9.5	0.375	43.9	1.73	25.4	1.00	27.2	1.07	5.6	0.22	12.70	0.500
1/2 x 3/8	9/16-18	5/8	7.0	0.281	9.5	0.375	45.0	1.77	25.4	1.00	27.9	1.10	6.4	0.25	12.70	0.500
5/8 x 1/4	7/16-20	11/16	5.2	0.203	12.7	0.500	47.0	1.85	27.7	1.09	29.0	1.14	6.4	0.25	15.88	0.625
5/8 x 3/8	9/16-18	11/16	7.0	0.281	12.7	0.500	47.2	1.86	27.7	1.09	30.5	1.20	6.4	0.25	15.88	0.625
5/8 x 1/2	3/4-16	13/16	10.7	0.422	12.7	0.500	49.8	1.96	27.7	1.09	30.5	1.20	6.4	0.25	15.88	0.625
3/4 x 1/4	7/16-20	13/16	5.2	0.203	15.9	0.625	48.8	1.92	29.5	1.16	29.0	1.14	6.4	0.25	19.05	0.750
3/4 x 3/8	9/16-18	13/16	7.0	0.281	15.9	0.625	49.0	1.93	29.5	1.16	30.5	1.20	6.4	0.25	19.05	0.750
3/4 x 1/2	3/4-16	13/16	10.7	0.422	15.9	0.625	51.6	2.03	29.5	1.16	30.5	1.20	6.4	0.25	19.05	0.750
3/4 x 5/8	7/8-14	15/16	12.7	0.500	15.9	0.625	54.6	2.15	29.5	1.16	31.8	1.26	7.9	0.31	19.05	0.750
1 x 1/2	3/4-16	1-1/16	10.7	0.422	21.4	0.844	52.1	2.05	28.4	1.12	27.9	1.10	7.9	0.31	25.40	1.000
1 x 5/8	7/8-14	1-1/16	12.7	0.500	21.4	0.844	53.6	2.11	28.4	1.12	27.9	1.10	7.9	0.31	25.40	1.000
1 x 3/4	1-1/16-12	1-1/8	16.6	0.656	21.4	0.844	56.9	2.24	28.4	1.12	29.7	1.17	9.7	0.38	25.40	1.000
1-1/4 x 5/8	7/8-14	1-3/8	12.7	0.500	26.2	1.031	56.4	2.22	29.5	1.16	29.0	1.14	9.7	0.38	31.75	1.250
1-1/4 x 3/4	1-1/16-12	1-3/8	16.6	0.656	26.2	1.031	58.2	2.29	29.5	1.16	30.5	1.20	9.7	0.38	31.75	1.250
1-1/4 x 1	1-5/16-12	1-3/8	22.2	0.875	26.2	1.031	57.9	2.28	29.5	1.16	31.2	1.23	9.7	0.38	31.75	1.250

[a] For dimensions shown on Figure 30 but not specified in above table, see corresonding dimensions for the specified tube outside diameter in Table 9.

[b] Minimum design thickness, not subject to inspection.

[c] See Table 1 for tolerance.

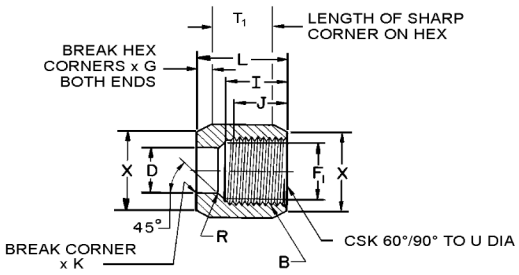


FIGURE 31—NUT (080110)

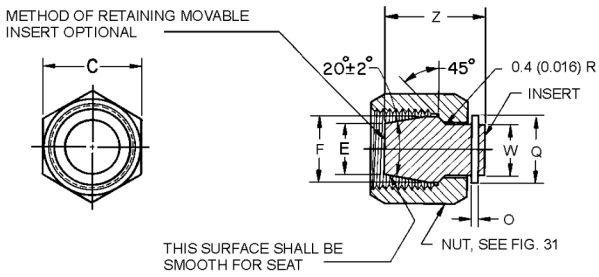


FIGURE 32—CAP ASSEMBLY (080112)

TABLE 12—DIMENSIONS OF NUT AND CAP ASSEMBLY (FIGURES 31 AND 32)

Nom tube OD, in	B Thread Size, in SAE J475 (ISO R725) Class 2B Int	C Hex Nom, in	D Dia mm	D Dia tol –0.00	D Dia in	D Dia tol –0.000	E Dia mm +0.13 –0.00	E Dia in +0.005 –0.000	F Dia mm ±0.5	F Dia in ±0.02	F_1 Dia mm ±0.13	F_1 Dia in ±0.005	G Min. mm	G Min. in	I mm +0.40 –0.00	I in +0.016 –0.000	J Full Thread Min mm	J Full Thread Min in	K mm	K in
1/8	5/16-24	3/8	3.30	+0.10 –0.00	0.130	+0.004 –0.000	3.20	0.126	5.6	0.22	—	—	0.4	0.016	9.86	0.388	8.3	0.328	0.5	0.02
3/16	3/8-24	7/16	4.90	+0.10 –0.00	0.193	+0.004 –0.000	4.75	0.187	7.1	0.28	—	—	0.4	0.016	11.66	0.459	10.3	0.406	0.5	0.02
1/4	7/16-20	9/16	6.48	+0.10 –0.00	0.255	+0.004 –0.000	6.40	0.252	8.6	0.34	—	—	0.4	0.016	13.64	0.537	11.9	0.469	0.5	0.02
5/16	1/2-20	5/8	8.08	+0.10 –0.00	0.318	+0.004 –0.000	8.00	0.315	10.4	0.41	—	—	0.4	0.016	14.02	0.552	12.3	0.483	0.5	0.02
3/8	9/16-18	11/16	9.65	+0.10 –0.00	0.380	+0.004 –0.000	9.58	0.377	11.9	0.47	—	—	0.4	0.016	14.43	0.568	12.7	0.500	0.5	0.02
1/2	3/4-16	7/8	12.83	+0.13 –0.00	0.505	+0.005 –0.000	12.78	0.503	15.7	0.62	—	—	0.4	0.016	15.21	0.599	13.1	0.516	0.5	0.02
5/8	7/8-14	1	16.03	+0.13 –0.00	0.631	+0.005 –0.000	16.00	0.630	19.0	0.75	—	—	0.5	0.020	17.20	0.677	14.7	0.578	0.5	0.02
3/4	1-1/16-12	1-1/4	19.20	+0.13 –0.00	0.756	+0.005 –0.000	19.18	0.755	22.4	0.88	—	—	0.5	0.020	17.20	0.677	14.3	0.562	0.8	0.03
7/8	1-3/16-12	1-3/8	22.38	+0.13 –0.00	0.881	+0.005 –0.000	22.22	0.875	25.4	1.00	—	—	0.7	0.028	17.20	0.677	14.3	0.562	0.8	0.03
1	1-5/16-12	1-1/2	25.55	+0.13 –0.00	1.006	+0.005 –0.000	25.53	1.005	29.5	1.16	—	—	0.7	0.028	17.20	0.677	14.3	0.562	0.8	0.03
1-1/4	1- 5/8-12	2	32.00	+0.15 –0.00	1.260	+0.006 –0.000	31.93	1.257	35.8	1.41	36.73	1.446	0.9	0.035	16.38	0.645	13.5	0.531	0.8	0.03
1-1/2	1- 7/8-12	2-1/4	38.35	+0.15 –0.00	1.510	+0.006 –0.000	38.28	1.507	42.2	1.66	43.05	1.695	0.9	0.035	16.23	0.639	13.1	0.515	0.8	0.03
2	2- 1/2-12	2-7/8	51.16	+0.15 –0.00	2.014	+0.006 –0.000	50.80	2.000	55.6	2.19	58.04	2.285	1.2	0.047	15.62	0.615	12.7	0.500	0.8	0.03

Continued on next page.

TABLE 12—DIMENSIONS OF NUT AND CAP ASSEMBLY (FIGURES 31 AND 32) (CONTINUED)

Nom Tube OD, in	L mm ±0.5	L in ±0.02	O mm ±0.4	O in ±0.016	Q Max mm	Q Max in	R Rad mm	R Rad in	T_1 Min. mm	T_1 Min. in	U Dia mm +0.4 −0.0	U Dia in +0.016 −0.000	W Dia mm +0.10 −0.00	W Dia in +0.004 −0.000	X Dia mm ±0.3	X Dia in ±0.01	Z Max mm	Z Max in
1/8	13.5	0.53	1.3	0.05	6.4	0.25	0.8	0.031	9.0	0.354	8.1	0.317	3.18	0.125	9.1	0.36	14.7	0.58
3/16	15.5	0.61	1.3	0.05	6.4	0.25	0.8	0.031	10.5	0.413	9.7	0.380	4.60	0.181	10.7	0.42	16.2	0.64
1/4	17.8	0.70	1.3	0.05	9.7	0.38	0.8	0.031	11.5	0.453	11.3	0.443	6.25	0.246	13.7	0.54	18.3	0.72
5/16	18.3	0.72	1.3	0.05	12.7	0.50	0.8	0.031	11.5	0.453	12.8	0.505	7.87	0.310	15.2	0.60	18.8	0.74
3/8	19.0	0.75	1.3	0.05	12.7	0.50	0.8	0.031	12.0	0.472	14.4	0.567	9.45	0.372	17.0	0.67	19.5	0.77
1/2	21.3	0.84	1.5	0.06	15.7	0.62	1.2	0.047	13.0	0.512	19.2	0.755	12.65	0.498	21.8	0.86	23.6	0.93
5/8	23.4	0.92	1.5	0.06	19.0	0.75	1.2	0.047	14.0	0.551	22.4	0.880	15.88	0.625	24.9	0.98	23.9	0.94
3/4	24.6	0.97	1.5	0.06	22.4	0.88	1.2	0.047	14.0	0.551	27.1	1.067	19.05	0.750	31.5	1.24	23.6	0.93
7/8	25.4	1.00	1.5	0.06	25.4	1.00	1.2	0.047	13.5	0.531	30.3	1.193	22.22	0.875	34.5	1.36	24.4	0.96
1	26.7	1.05	2.3	0.09	31.8	1.25	1.6	0.062	13.5	0.531	33.5	1.317	25.40	1.000	37.6	1.48	27.4	1.08
1-1/4	26.7	1.05	3.0	0.12	38.1	1.50	1.6	0.062	10.0	0.394	41.4	1.630	31.75	1.250	50.3	1.98	30.2	1.19
1-1/2	26.2	1.03	4.1	0.16	44.4	1.75	1.6	0.062	8.0	0.315	47.8	1.880	38.10	1.500	56.9	2.24	32.7	1.29
2	28.4	1.12	4.1	0.16	57.2	2.25	1.6	0.062	5.5	0.217	63.6	2.505	50.80	2.000	72.6	2.86	32.3	1.27

NOTE— Table 13 and Figure 33 have intentionally been deleted from this document. See SAE J1926, Specification for Straight Thread O-Ring Boss Port.

7. ***Section 3—O-Ring Plugs.*** Specifications for straight thread O-ring port into which connector and adjustable styles of hydraulic tube fittings assemble are given in SAE J1926. O-ring boss plugs shall be as shown in Figure 34 and Table 14. For specifications of O-rings used in conjunction with these fittings, see SAE J515. Assembly instruction for O-ring fittings are shown in Figures 36 and 37.

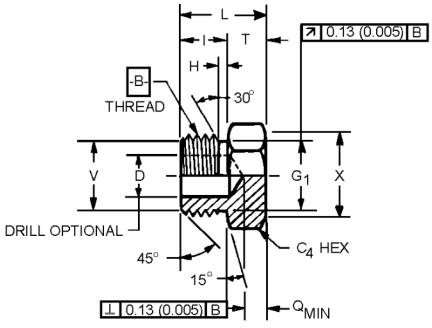


FIGURE 34A—HEXAGON HEAD
O-RING BOSS PLUG (090109A)

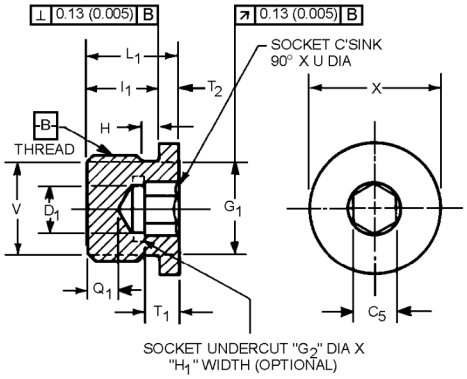


FIGURE 34B—HEXAGON SOCKET
O-RING BOSS PLUG (090109B)

TABLE 14—DIMENSIONS[a] OF O-RING BOSS PLUS (FIGURES 34A TO 34B)

Nom tube OD, in	B Thread Size, in SAE J475 (ISO R725) Class 2A Ext. in	C_4 Hex Nom	C_5 Hex Socket mm +0.13 −0.00	C_4 Hex Socket in +0.005 −0.000	D[d] Drill mm	D[d] Drill in	D_1 Dia mm +0.13 −0.00	D_1 Dia in +0.005 −0.000	G_1[b] Dia mm +0.05 −0.08	G_1[b] Dia in +0.002 −0.003	G_2 Dia Optional mm +0.25 −0.00	G_2 Dia Optional in +0.010 −0.000	H mm +0.8 −0.0	H in +0.030 −0.000	H_1 Optional mm ±0.5	H_1 Optional in ±0.020
1/8	5/16-24	7/16	3.18	0.125	2.4	0.093	3.18	0.125	6.35	0.250	4.0	0.156	1.6	0.063	1.6	0.063
3/16	3/8-24	1/2	3.18	0.125	3.2	0.125	3.18	0.125	7.95	0.313	4.0	0.156	1.6	0.063	1.6	0.063
1/4	7/16-20	9/16	4.78	0.188	5.2	0.203	4.78	0.188	9.25	0.364	5.9	0.234	1.9	0.075	2.4	0.094
5/16	1/2-20	5/8	4.78	0.188	5.9	0.234	4.78	0.188	10.85	0.427	5.9	0.234	1.9	0.075	2.4	0.094
3/8	9/16-18	11/16	6.35	0.250	7.5	0.297	6.35	0.250	12.24	0.482	7.5	0.297	2.1	0.083	2.4	0.094
1/2	3/4-16	7/8	7.95	0.313	10.7	0.422	7.95	0.313	16.76	0.660	9.7	0.380	2.4	0.094	2.4	0.094
5/8	7/8-14	1	9.52	0.375	12.7	0.500	9.52	0.375	19.63	0.773	11.3	0.443	2.7	0.107	2.4	0.094
3/4	1-1/16-12	1-1/4	14.30	0.563	16.7	0.656	14.30	0.563	24.00	0.945	16.8	0.661	3.2	0.125	3.2	0.125
7/8	1-3/16-12	1-3/8	14.30	0.563	18.2	0.718	14.30	0.563	27.18	1.070	16.8	0.661	3.2	0.125	3.2	0.125
1	1-5/16-12	1-1/2	15.88	0.625	22.2	0.875	15.88	0.625	30.35	1.195	18.8	0.740	3.2	0.125	3.2	0.125
1-1/4	1- 5/8-12	1-7/8	19.05	0.750	27.8	1.093	19.05	0.750	38.28	1.507	22.2	0.875	3.2	0.125	3.2	0.125
1-1/2	1- 7/8-12	2-1/8	19.05	0.750	34.1	1.344	19.05	0.750	44.60	1.756	22.2	0.875	3.2	0.125	3.2	0.125
2	2- 1/2-12	2-3/4	19.05	0.750	46.1	1.813	19.05	0.750	60.48	2.381	22.2	0.875	3.2	0.125	3.2	0.125

Nom Tube OD, In	I_1 mm ±0.13	I_1 in ±0.005	L mm ±0.5	L in ±0.02	L_1 Ref mm	L_1 Ref in	Q Min mm	Q Min in	Q_1 Min mm	Q_1 Min in	T[c] Ref mm	T[c] Ref in	T_1 Min Hexagon Depth mm	T_1 Min Hexagon Depth in	T_2 mm +0.00 −0.25	T_2 in +0.000 −0.010	V Dia mm ±0.25	V Dia in ±0.010	X Dia mm ±0.13	X Dia in ±0.005	U Dia mm ±0.25	U Dia in ±0.010
1/8	7.54	0.297	15.2	0.60	10.2	0.40	1.5	0.06	2.8	0.11	7.1	0.28	3.18	0.125	2.74	0.108	6.25	0.245	11.13	0.438	4.0	0.156
3/16	7.54	0.297	15.2	0.60	10.2	0.40	2.0	0.08	2.8	0.11	7.1	0.28	3.18	0.125	2.74	0.108	7.75	0.305	12.70	0.500	4.0	0.156
1/4	9.14	0.360	17.0	0.67	11.9	0.47	2.5	0.10	3.0	0.12	7.1	0.28	3.96	0.156	2.92	0.115	9.15	0.360	14.30	0.563	5.6	0.219
5/16	9.14	0.360	17.0	0.67	11.9	0.47	3.0	0.12	3.0	0.12	7.1	0.28	3.96	0.156	2.92	0.115	10.65	0.420	15.88	0.625	5.6	0.219
3/8	9.93	0.391	18.5	0.73	12.7	0.50	4.1	0.16	3.0	0.12	7.9	0.31	4.77	0.188	2.92	0.115	12.05	0.475	17.48	0.688	7.5	0.297
1/2	11.13	0.438	20.3	0.80	14.7	0.58	5.6	0.22	3.8	0.15	8.6	0.34	4.77	0.188	3.73	0.147	16.65	0.655	22.23	0.875	9.5	0.375
5/8	12.70	0.500	23.6	0.93	16.5	0.65	6.4	0.25	3.8	0.15	10.4	0.41	6.35	0.250	3.94	0.155	19.55	0.770	25.40	1.000	11.1	0.438
3/4	15.09	0.594	27.7	1.09	19.5	0.77	6.4	0.25	3.8	0.15	11.9	0.47	7.95	0.313	4.60	0.181	23.90	0.940	31.75	1.250	16.7	0.656
7/8	15.09	0.594	27.7	1.09	19.5	0.77	6.4	0.25	3.8	0.15	11.9	0.47	7.95	0.313	4.60	0.181	27.05	1.065	34.93	1.375	16.7	0.656
1	15.09	0.594	28.4	1.12	19.5	0.77	6.4	0.25	4.8	0.19	12.7	0.50	9.52	0.375	4.60	0.181	30.25	1.190	38.10	1.500	18.6	0.734
1-1/4	15.09	0.594	30.5	1.20	19.5	0.77	6.4	0.25	4.8	0.19	14.7	0.58	9.52	0.375	4.60	0.181	38.10	1.500	47.63	1.875	23.0	0.906
1-1/2	15.09	0.594	32.3	1.27	19.5	0.77	6.4	0.25	6.4	0.25	16.5	0.65	9.52	0.375	4.60	0.181	44.45	1.750	53.98	2.125	23.0	0.906
2	15.09	0.594	36.3	1.43	19.5	0.77	7.6	0.30	6.4	0.25	20.6	0.81	9.52	0.375	4.60	0.181	60.35	2.375	69.85	2.750	23.0	0.906

[a] Modification of 1/8 to 1 in sizes for use with MS 33649 (or superseded AND 10050) bosses is shown in Figure 35 and Table 15.
[b] O-ring groove undercut must be smooth and free of tool marks.
[c] Minimum design thickness, not subject to inspection.
[d] See Table 1 for tolerance.

7.1 Deleted. Table 15 and Figure 35 associated with 7.1 also deleted. These items were intentionally deleted to discourage use of these industrial fittings in MS33649 port which is mainly used in military and aerospace applications.

7.2 Assembly Instructions for Adjustable Style Fittings in Straight Thread O-Ring Boss Ports. These instructions apply to the assembly of hydraulic fittings of the 37 degree flared type shown in Figures 9D, 10A, 10B, 10C, and 8A, and flareless type shown in Figures 26D, 27A, 27B, 27C, and 25A, and hydraulic O-rings, Figure 1 of SAE J515.

7.2.1 Lubricate the O-ring by coating with a system compatible lubricant and install in the groove adjacent to the face of the metal back-up washer which is assembled at the extreme end of the groove as shown in Figure 36B.

7.2.2 Install the fitting into the SAE straight thread port (see SAE J1926) until the metal back-up washer contacts the face of the port.

7.2.3 Position the fitting by turning out (counterclockwise) up to a maximum of one turn as shown in Figure 36C. Holding the pad of the fitting with a wrench, tighten the locknut and washer against the face of the port as shown in Figure 36D.

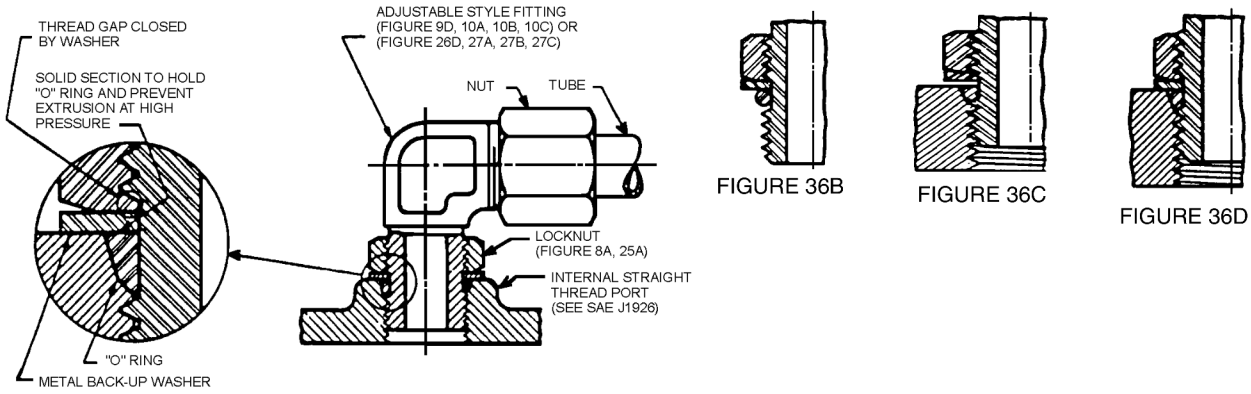


FIGURE 36A

FIGURE 36B

FIGURE 36C

FIGURE 36D

FIGURE 36—ADJUSTABLE STYLE FITTINGS

7.3 Assembly Instructions for Swivel Style and O-Ring Boss Fittings in Straight Thread O-Ring Ports. These instructions apply to the assembly of hydraulic fittings of the 37 degree flared type shown in Figures 3B and 3C, flareless type shown in Figures 20B and 20C, and O-ring boss plugs shown in Figure 34.

7.3.1 Lubricate O-ring by coating with a system compatible lubricant and install in the O-ring groove on the fitting.

7.3.2 Screw fitting into the straight thread port and tighten hexagon against the face of the port as shown in Figure 37C.

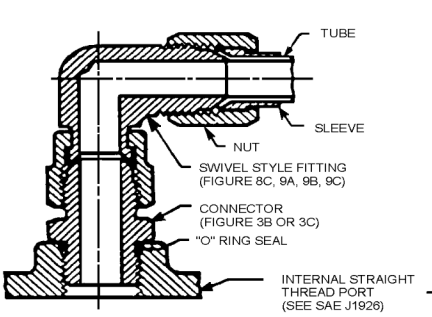


FIGURE 37A

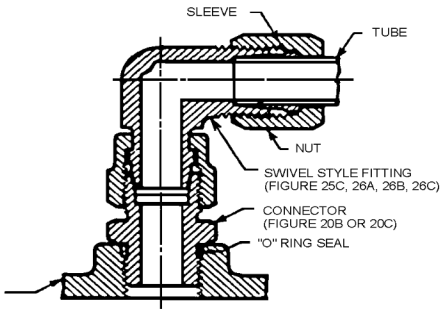


FIGURE 37B

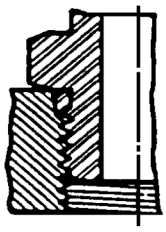


FIGURE 37C

FIGURE 37—SWIVEL STYLE FITTINGS

8. Section 4—Hydraulic Pipe Fittings. Hydraulic pipe fittings are shown in Figures 38 to 46 and Tables 16 to 19.

NOTE— UNSPECIFIED DETAIL WITH RESPECT TO DIMENSIONS, TOLERANCES, CONTOURS, MATERIAL, AND WORKMANSHIP MUST CONFORM TO GENERAL SPECIFICATIONS FOR HYDRAULIC PIPE FITTINGS. CODES SHOWN IN BRACKETS ADJACENT TO FIGURE NUMBERS REPRESENT RESPECTIVE FITTING IDENTIFICATION IN ACCORDANCE WITH SAE J846.

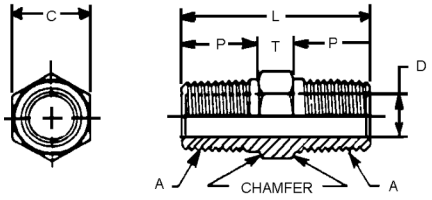


FIGURE 38—HEXAGON PIPE NIPPLE (140137)

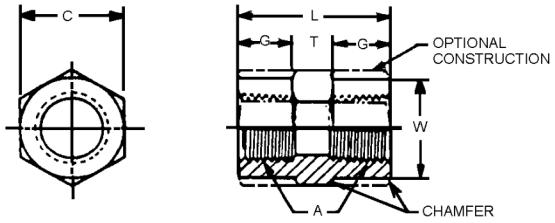


FIGURE 39—HEXAGON PIPE COUPLING (140138)

TABLE 16—DIMENSIONS OF HEXAGON PIPE NIPPLES (FIGURE 38)

A Dryseal Pipe Thread SAE J476 (ANSI B1.20.3)	C Hex Nom	D[b] Drill mm	D[b] Drill in	L mm ±0.5	L in ±0.02	P Min mm	P Min in	T[a] Ref mm	T[a] Ref in
1/8-27	7/16	4.8	0.188	26.9	1.06	9.7	0.38	5.6	0.22
1/4-18	5/8	7.0	0.281	36.8	1.45	14.2	0.56	6.4	0.25
3/8-18	3/4	10.3	0.406	36.8	1.45	14.2	0.56	6.4	0.25
1/2-14	7/8	13.5	0.531	48.0	1.89	19.0	0.75	7.9	0.31
3/4-14	1-1/8	18.0	0.719	49.8	1.96	19.0	0.75	9.7	0.38
1-11-1/2	1-3/8	23.8	0.938	59.4	2.34	23.9	0.94	9.7	0.38
1-1/4-11-1/2	1-3/4	31.7	1.250	63.0	2.48	24.6	0.97	11.7	0.46
1-1/2-11-1/2	2	38.0	1.500	66.3	2.61	25.4	1.00	13.5	0.53
2-11-1/2	2-1/2	49.0	1.938	71.6	2.82	26.2	1.03	17.3	0.68

[a] Minimum design thickness, not subject to inspection.
[b] See Table 1 for tolerance.

TABLE 17—DIMENSIONS OF HEXAGON PIPE COUPLING (FIGURE 39)

A Dryseal Pipe Thread SAE J476 (ANSI B1.20.3)	C Hex Nom	G[a] Ref mm	G[a] Ref in	L mm ±0.5	L in ±0.02	T Ref Min mm	T Ref Min in	W Dia mm +0.00 –0.5	W Dia in +0.00 –0.02
1/8-27	5/8	6.4	0.25	19.0	0.75	5.6	0.22	15.88	0.625
1/4-18	3/4	10.9	0.43	28.7	1.13	6.4	0.25	19.05	0.750
3/8-18	7/8	10.9	0.43	28.7	1.13	6.4	0.25	22.22	0.875
1/2-14	1-1/8	14.2	0.56	38.1	1.50	7.9	0.31	28.58	1.125
3/4-14	1-3/8	14.2	0.56	38.9	1.53	9.7	0.38	34.92	1.375
1-11-1/2	1-5/8	17.5	0.69	48.0	1.89	9.7	0.38	41.28	1.625
1-1/4-11-1/2	2	17.5	0.69	49.0	1.93	11.7	0.46	50.80	2.000
1-1/2-11-1/2	2-3/8	17.5	0.69	49.0	1.93	13.5	0.53	60.32	2.375
2-11-1/2	2-7/8	16.0	0.63	49.8	1.96	17.3	0.68	73.03	2.875

[a] Reference dimension, not subject to inspection.

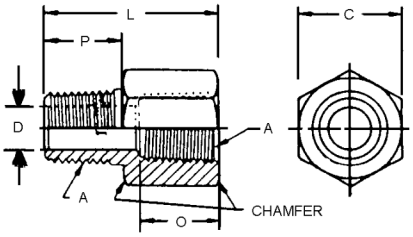


FIGURE 40—ADAPTER (140139)

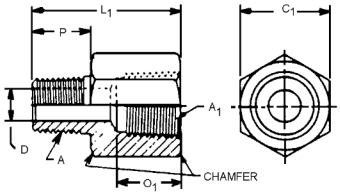


FIGURE 41—INCREASE ADAPTERS (140139)

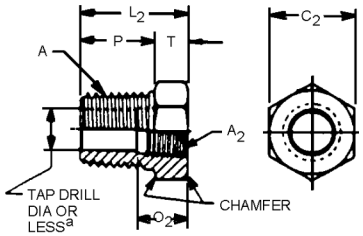


FIGURE 42—REDUCER BUSHINGS (140140)

TABLE 18—DIMENSIONS OF ADAPTERS, INCREASE ADAPTERS, AND REDUCER BUSHINGS (FIGURES 40, 41, AND 42)

Dryseal Pipe Thread SAE J476 (ANSI B1.20.3) A Adapter	Dryseal Pipe Thread SAE J476 (ANSI B1.20.3) A x A_1 Increase Adapter	Dryseal Pipe Thread SAE J476 (ANSI B1.20.3) A x A_2 Reducer Bushing	C Hex Nom	C_1 Hex Nom	C_2 Hex Nom	D[c] Drill mm	D[c] Drill in	L mm ±0.5	L in ±0.02	L_1 mm ±0.5	L_1 in ±0.02	L_2 mm ±0.5	L_2 in ±0.02	O Min mm	O Min in	O_1 Min mm	O_1 Min in	O_2[a] Min mm	O_2[a] Min in	P Min mm	P Min in	T[b] Ref mm	T[b] Ref in
1/8-27	1/8 x 1/4	—	5/8	3/4	—	4.8	0.188	26.4	1.04	30.7	1.21	—	—	9.7	0.38	14.2	0.56	—	—	9.7	0.38	—	—
1/4-18	1/4 x 3/8	1/4 x 1/8	3/4	7/8	5/8	7.0	0.281	35.3	1.39	36.6	1.44	21.6	0.85	14.2	0.56	14.7	0.58	9.7	0.38	14.2	0.56	6.4	0.25
3/8-18	3/8 x 1/2	3/8 x 1/4	7/8	1-1/8	3/4	10.3	0.406	36.6	1.44	42.7	1.68	21.6	0.85	14.7	0.58	19.0	0.75	14.2	0.56	14.2	0.56	6.4	0.25
1/2-14	1/2 x 3/4	1/2 x 3/8	1-1/8	1-3/8	7/8	13.5	0.531	47.5	1.87	49.0	1.93	27.9	1.10	19.0	0.75	19.6	0.77	14.7	0.58	19.0	0.75	7.9	0.31
3/4-14	3/4 x 1	3/4 x 1/2	1-3/8	1-5/8	1-1/8	18.0	0.719	49.0	1.93	55.4	2.18	29.7	1.17	19.6	0.77	23.9	0.94	19.0	0.75	19.0	0.75	9.7	0.38
1-11-1/2	1 x 1-1/4	1 x 1-3/4	1-5/8	2	1-3/8	23.8	0.938	60.2	2.37	62.5	2.46	34.5	1.36	23.9	0.94	23.9	0.94	19.6	0.77	23.9	0.94	9.7	0.38
1-1/4-11-1/2	1-1/4 x 1-1/2	1-1/4 x 1	2	2-3/8	1-3/4	31.7	1.250	63.2	2.49	63.5	2.50	37.3	1.47	23.9	0.94	23.9	0.94	23.9	0.94	24.6	0.97	11.7	0.46
1-1/2-11-1/2	1-1/2 x 2	1-1/2 x 1-1/4	2-3/8	2-7/8	2	38.0	1.500	64.3	2.53	66.8	2.63	39.9	1.57	23.9	0.94	24.6	0.97	23.9	0.94	25.4	1.00	13.5	0.53
2-11-1/2	—	2 x 1-1/2	2-7/8	—	2-1/2	49.0	1.938	67.6	2.66	—	—	44.5	1.75	24.6	0.97	—	—	23.9	0.94	26.2	1.03	17.3	0.68

[a] Beyond top drill depth O_2, hole may be reduced below tap drill diameter, but shall not be less than D diameter in corresponding external pipe size adapter.
[b] Minimum design thickness, not subject to inspection.
[c] See Table 1 for tolerance.

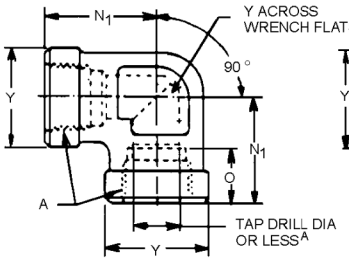


FIGURE 43A—90 DEGREE PIPE ELBOW (140238)

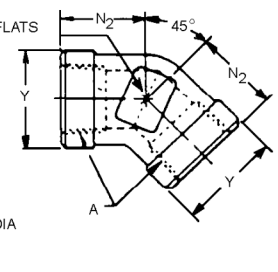


FIGURE 43B—45 DEGREE PIPE ELBOW (140338)

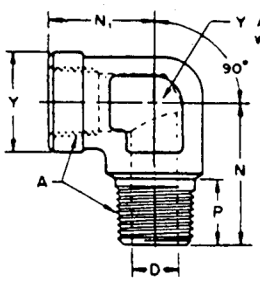


FIGURE 43C—90 DEGREE STREET ELBOW (140239)

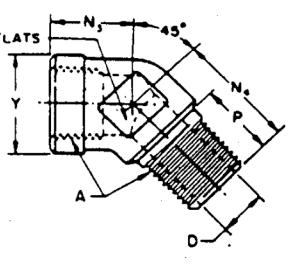


FIGURE 43D—45 DEGREE STREET ELBOW (140339)

NOTE—FIGURES 43A TO 43D AND 46A TO 46C DEPICT FORGED CONSTRUCTION AND ARE OPTIONAL WITH SOLID OR FABRICATED BAR STOCK CONSTRUCTION DEPICTED IN FIGURES 44A to 45D.

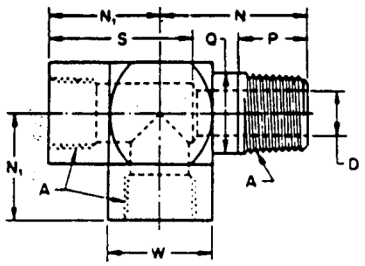


FIGURE 44A—PIPE TEE INTERNAL, EXTERNAL, INTERNAL (140424)

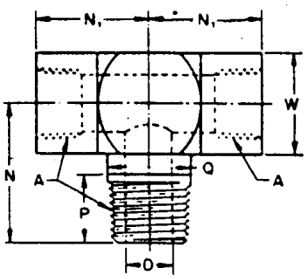


FIGURE 44B—PIPE TEE INTERNAL, INTERNAL, EXTERNAL (14025)

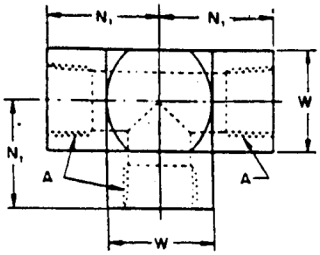


FIGURE 44C—PIPE TEE INTERNAL, INTERNAL, INTERNAL (140438)

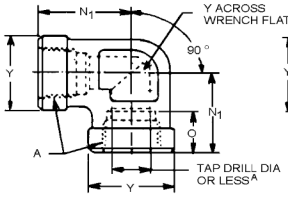


FIGURE 45A—90 DEGREE PIPE ELBOW (140238)

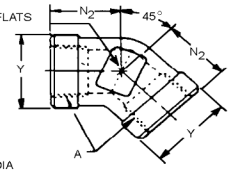


FIGURE 45B—45 DEGREE PIPE ELBOW (140338)

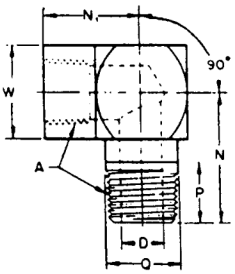


FIGURE 45C—90 DEGREE STREET ELBOW (140239)

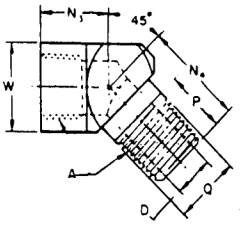


FIGURE 45D—45 DEGREE STREET ELBOW (140339)

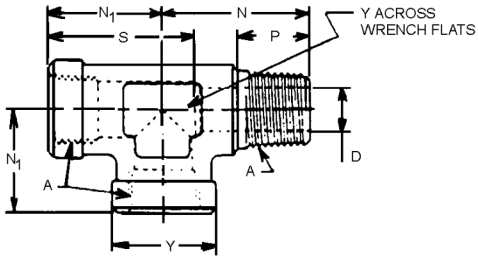


FIGURE 46A—PIPE TEE INTERNAL, EXTERNAL, INTERNAL (140424)

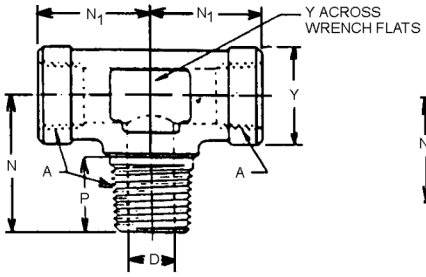


FIGURE 46B—PIPE TEE INTERNAL INTERNAL, EXTERNAL (140425)

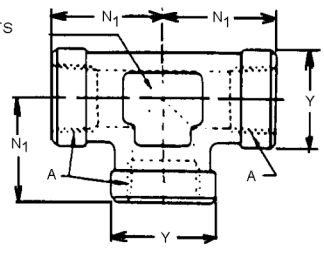


FIGURE 46C—PIPE TEE INTERNAL INTERNAL, INTERNAL (140438)

NOTES—UNSPECIFIED DETAIL WITH RESPECT TO DIMENSIONS, TOLERANCES, CONTOURS, MATERIAL, AND WORKMANSHIP MUST CONFORM TO GENERAL SPECIFICATIONS FOR HYDRAULIC PIPE FITTINGS. THE DIMENSIONAL DESIGNATIONS FOR TAP DRILL AND NOTES SHOWN ON FIGURES 6 AND 13 SHALL APPLY TO CORRESPONDING FEATURES OF FIGURES 7 TO 12 AND FIGURES 45 TO 46C UNLESS SHOWN OTHERWISE.

TABLE 19—DIMENSIONS OF FORGED AND BARSTOCK TYPES OF PIPE ELBOWS, STREET ELBOWS, AND PIPE TEES (FIGURES 43A TO 46C)

A Dryseal Pipe Thread SAE J476 (ANSI B1.20.3)	D[a][d] Drill mm	D[a][d] Drill in	N mm ±0.8	N in ±0.03	N_1 mm ±0.8	N_1 in ±0.03	N_2 mm ±0.8	N_2 in ±0.03	N_3 mm ±0.8	N_3 in ±0.03	N_4 mm ±0.8	N_4 in ±0.03	O[a] Min mm	O[a] Min in	P Min mm	P Min in	Q Dia Min mm	Q Dia Min in	S[b] Min mm	S[b] Min in	W Square or Dia max mm	W Square or Dia max in	Y[c] mm +0.0	Y[c] in +0.000
1/8–27	4.8	0.188	19.8	7.8	16.8	0.66	12.7	0.50	11.9	0.47	18.3	0.72	9.6	0.38	9.7	0.38	11.2	0.44	23.9	0.94	15.7	0.62	14.3–0.8	0.562–0.030
1/4–18	7.0	0.281	27.7	1.09	22.4	0.88	17.5	0.69	15.7	0.62	26.7	1.05	14.2	0.56	9.7	0.38	14.2	0.56	29.0	1.14	19.0	0.75	19.0–0.8	0.750–0.030
3/8–18	10.3	0.406	31.0	1.22	25.9	1.02	19.0	0.75	18.3	0.72	26.9	1.06	14.7	0.58	14.2	0.56	17.3	0.68	33.8	1.33	22.3	0.88	22.2–0.8	0.875–0.030
1/2–14	13.5	0.531	37.3	1.47	31.2	1.23	23.9	0.94	23.1	0.91	34.0	1.34	19.0	0.75	19.0	0.75	22.4	0.88	41.1	1.62	28.4	1.12	27.0–1.0	1.062–0.040
3/4–14	18.0	0.719	40.4	1.59	34.5	1.36	25.4	1.00	24.6	0.97	35.1	1.38	19.6	0.77	19.0	0.75	26.9	1.06	47.2	1.86	35.0	1.38	33.3–1.0	1.312–0.040
1-11-1/2	23.8	0.938	50.0	1.7	41.1	1.62	30.2	1.19	28.4	1.12	43.7	1.72	23.8	0.94	23.9	0.94	35.1	1.38	56.6	2.23	41.1	1.62	41.3–1.0	1.625–0.040
1-1/4–11-1/2	31.7	1.250	60.5	2.38	43.2	1.70	36.6	1.44	41.4	1.63	45.7	1.80	23.8	0.94	23.9	0.94	42.9	1.69	62.7	2.47	50.8	2.00	47.6–1.0	1.875–0.040
1-1/2–11-1/2	38.0	1.500	67.1	2.64	52.8	2.08	37.1	1.46	42.9	1.69	52.3	2.06	23.8	0.94	25.4	1.00	48.3	1.90	75.4	2.97	60.5	2.38	65.1–1.0	2.562–0.040
2–11-1/2	49.0	1.938	76.2	3.00	60.7	2.39	40.4	1.59	55.6	2.19	54.6	2.15	24.6	0.97	26.2	1.03	60.5	2.38	89.4	3.52	73.2	2.88	71.4–1.0	2.812–0.040

a Beyond tap drill depth O, hole may be reduced to below tap drill diameter, but shall not be less than D drill for corresonding size. See Figures 43A and 45A.
b Maximum depth shall be optional with manufacturer provided that strength of fitting is not impaired.
c The basic dimension shown shall apply as minimum for boss diameter.
d See Table 1 for tolerance.

9. Section 5—Adapter Unions. Adapter union fittings are shown in Figures 47A to 49C and Tables 20 and 21.

NOTE—Unspecified detail with respect to dimensions, tolerances, contours, material workmanship, and so on, must conform to general specifications for hydraulic hose fittings. The dimensional designations on the first figure in each group shall apply to all other figures in that group except as shown otherwise. The design of and method of attaching swivel nut shall be optional with manufacturer, providing the dimensions shown are maintained and nut turns freely. Codes shown in brackets adjacent to figure numbers represent respective fitting identification in accordance with SAE J846.

9.1 Pressure ratings for adapter unions are specified in Table 20 and are based on a 4:1 safety factor. Variations from these values may be necessary, depending on the severity of the application, but shall be altered only with the consent of both the user and the fitting manufacturer.

TABLE 20—PRESSURE RATINGS OF ADAPTER UNIONS

A_1 Straight Pipe Thread (NPSM) d	Max Operating Pressure[(a)] MPa	Max Operating Pressure[(a)] psi
–2	34.5	5000
–4	34.5	5000
–6	27.6	4000
–8	24.1	3500
–12	15.5	2250
–16	13.8	2000
–20	11.2	1625
–24	8.6	1250
–32	7.8	1125

[(a)] Pressure ratings shown are the pressure ratings for the fitting and are not necessarily the pressure ratings applicable in an assembly with hydraulic hose. The applicable pressure rating for an assembly with hydraulic hose is the lower value specified for the hose and the fitting unless otherwise agreed to by the supplier and user.

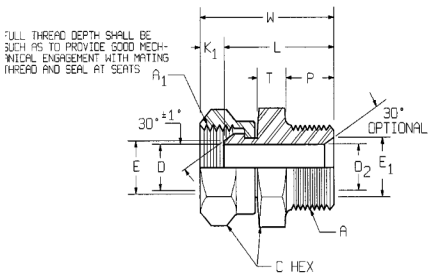


FIGURE 47A—FEMALE ADAPTER UNION TO MALE PIPE (140130)

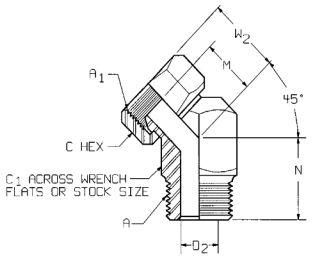


FIGURE 47B—45° FEMALE ADAPTER UNION TO MALE PIPE (140330)

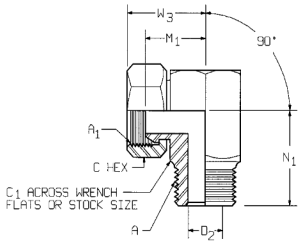


FIGURE 47C—90° FEMALE ADAPTER UNION TO MALE PIPE (140230)

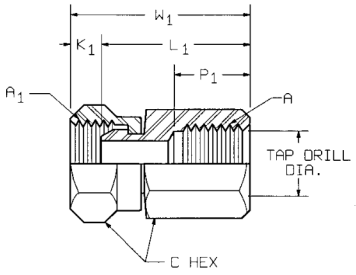


FIGURE 48A—FEMALE ADAPTER UNION TO FEMALE PIPE (140131)

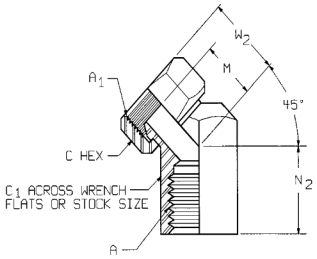


FIGURE 48B—45° FEMALE ADAPTER UNION TO FEMALE PIPE (140331)

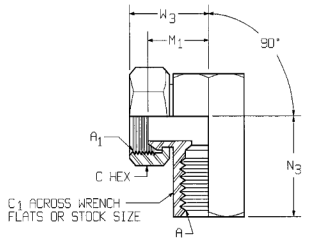


FIGURE 48—90° FEMALE ADAPTER UNION TO FEMALE PIPE (140231)

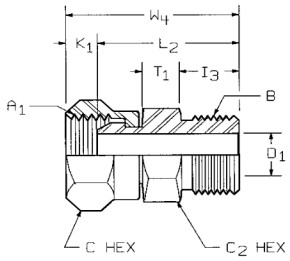


FIGURE 49A—FEMALE ADAPTER UNION TO MALE STRAIGHT THREAD (140157)

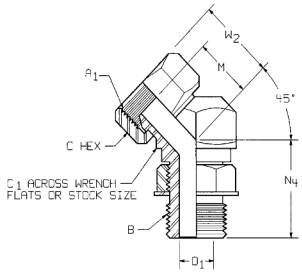


FIGURE 49B—45° FEMALE ADAPTER UNION TO ADJ. MALE STRAIGHT THREAD (140357)

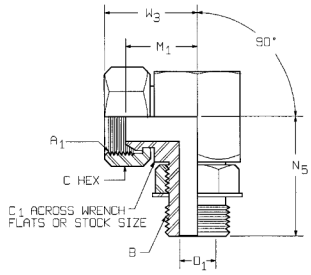


FIGURE 49C—90° FEMALE ADAPTER UNION TO ADJ. MALE STRAIGHT THREAD (140257)

TABLE 21—DIMENSIONS OF ADAPTER UNIONS (FIGURES 47A TO 49C)

Nominal Tube Size	Pipe Thread Dash Size	A Dryseal Pipe Thread (NPTF) (SAE J476[e]) (ANSI B1.20.3)	A_1 Straight Pipe Thread NPSM[d]	B Thread Size, In (ISO R725) SAE J475 Class 2A, Int Class 2B, Ext	C Hex Nom	C_1 Forging mm	C_1 Forging in	C_1 Bar Stock mm max	C_1[f] Bar Stock in max	C_2 Hex Nom	D Dia min mm	D Dia min in	D Dia max mm	D Dia max in	D_1 Min Dia mm	D_1 Min Dia in	D_2 Min Dia mm	D_2 Min Dia in
1/4	–2	1/8-27	1/8-27	7/16-20	9/16	11.1	0.44	14.3	0.56	9/16	2.8	0.11	4.8	0.19	2.8	0.11	3.3	0.13
3/8	–4	1/4-18	1/4-18	9/16-18	11/16	12.7	0.50	20.6	0.81	11/16	5.3	0.21	5.8	0.23	5.3	0.21	5.6	0.22
1/2	–6	3/8-18	3/8-18	3/4-16	7/8	19.1	0.75	22.4	0.88	7/8	8.1	0.32	9.1	0.36	8.4	0.33	8.4	0.33
5/8	–8	1/2-14	1/2-14	7/8-14	1	22.4	0.88	28.7	1.13	1	11.2	0.44	12.2	0.48	11.4	0.45	11.9	0.47
3/4	–12	3/4-14	3/4-14	1-1/16-12	1-1/4	33.3	1.31	35.1	1.38	1-1/4	15.5	0.61	16.8	0.66	15.2	0.60	16.5	0.65
1	–16	1-11-1/2	1-11-1/2	1-5/16-12	1-1/2	33.3	1.31	41.4	1.63	1-1/2	19.8	0.78	22.4	0.88	21.1	0.83	21.1	0.83
1-1/4	–20	1-1/4-11-1/2	1-1/4-11-1/2	1 -5/8-12	1-7/8	41.4	1.63	54.1	2.13	1-7/8	25.7	1.01	29.5	1.16	27.2	1.07	28.4	1.12
1-1/2	–24	1-1/2-11-1/2	1-1/2-11-1/2	1- 7/8-12	2-1/8	47.8	1.88	57.2	2.25	2-1/8	31.8	1.25	35.0	1.38	33.0	1.30	34.5	1.36
2	–32	2-11-1/2	2-11-1/2	2- 1/2-12	2-5/8	63.5	2.50	82.3	3.25	2-3/4	43.7	1.72	47.7	1.88	45.0	1.77	45.5	1.79

Nominal Tube Size	E Dia mm ±0.25	E Dia in ±0.010	E_1 Dia mm ±0.25	E_1 Dia in ±0.010	l_3 mm ±0.13	l_3 in ±0.005	K_1 mm min	K_1 in min	L mm max	L in max	L_1 mm max	L_1 in max	L_2 mm max	L_2 in max	M mm max	M in max	M_1 mm max	M_1 in max	N mm max	N in max	N_1 mm max	N_1 in max	N_2 mm max	N_2 in max	N_3 mm max	N_3 in max	N_4 mm max	N_4 in max
1/4	5.9	0.234	7.1	0.281	9.1	0.360	3.0	0.12	25.4	1.00	23.9	0.94	24.4	0.96	17.8	0.70	18.8	0.74	18.5	0.73	26.9	1.06	18.5	0.73	19.1	0.75	23.9	0.94
3/8	7.5	0.297	8.7	0.344	9.9	0.391	4.3	0.17	35.3	1.39	35.1	1.38	31.3	1.23	20.8	0.82	23.9	0.94	25.4	1.00	33.3	1.31	25.4	1.00	25.4	1.00	30.5	1.20
1/2	10.7	0.422	11.9	0.469	11.1	0.438	4.8	0.19	37.3	1.47	35.3	1.39	32.8	1.29	24.1	0.95	28.4	1.12	28.4	1.12	39.6	1.56	28.4	1.21	28.4	1.12	34.5	1.36
5/8	14.3	0.562	15.9	0.625	12.7	0.500	6.6	0.26	44.7	1.76	39.6	1.56	35.6	1.40	23.9	0.94	28.2	1.11	36.6	1.44	47.5	1.87	36.6	1.44	34.8	1.37	40.1	1.58
3/4	19.1	0.750	20.7	0.813	15.1	0.594	8.4	0.33	46.7	1.84	45.0	1.77	42.2	1.66	28.7	1.13	35.3	1.39	39.6	1.56	52.3	2.06	39.6	1.56	39.6	1.56	45.5	1.79
1	24.6	0.969	26.2	1.031	15.1	0.594	8.4	0.33	52.3	2.06	52.3	2.06	46.0	1.81	32.8	1.29	39.6	1.56	39.6	1.56	62.0	2.44	39.6	1.56	46.0	1.81	48.8	1.92
1-1/4	32.5	1.281	34.1	1.344	15.1	0.594	10.2	0.40	55.4	2.18	52.3	2.06	49.5	1.95	37.6	1.48	47.0	1.85	47.5	1.87	68.1	2.68	46.7	1.84	52.3	2.06	47.5	1.87
1-1/2	38.1	1.500	41.3	1.625	15.1	0.594	10.2	0.40	58.7	2.31	55.4	2.18	52.3	2.06	36.6	1.44	52.1	2.05	51.6	2.03	72.9	2.87	51.6	2.03	58.7	2.31	59.4	2.34
2	50.8	2.000	52.4	2.063	15.1	0.594	10.2	0.40	62.5	2.46	68.1	2.68	56.4	2.22	39.6	1.56	61.0	2.40	58.7	2.31	85.6	3.37	52.3	2.06	71.4	2.81	52.3	2.06

Nominal Tube Size	N_5 mm max	N_5 in max	P mm min	P in min	P_1 mm max	P_1 in max	T[c] mm min	T[c] in min	T_1[c] mm min	T_1[c] in min	W mm max	W in max	W_1 mm max	W_1 in max	W_2 mm max	W_2 in max	W_3 mm max	W_3 in max	W_4 mm max	W_4 in max
1/4	25.4	1.00	9.7	0.38	11.7	0.46	4.6	0.18	4.8	0.19	30.2	1.19	28.7	1.13	22.4	0.88	23.1	0.91	28.7	1.13
3/8	31.8	1.25	14.2	0.56	17.0	0.67	6.1	0.24	6.4	0.25	41.1	1.62	41.1	1.62	27.0	1.06	30.0	1.18	36.1	1.42
1/2	38.4	1.51	14.2	0.56	17.3	0.68	7.6	0.30	7.6	0.30	44.2	1.74	42.4	1.67	31.2	1.23	35.6	1.40	39.6	1.56
5/8	43.2	1.70	19.0	0.75	22.9	0.90	9.4	0.37	7.9	0.31	52.6	2.07	49.3	1.94	32.5	1.28	38.1	1.50	43.7	1.72
3/4	50.8	2.00	19.0	0.75	23.1	0.91	9.4	0.37	9.7	0.38	57.2	2.25	53.3	2.10	36.1	1.42	43.7	1.72	50.0	1.97
1	54.6	2.15	23.9	0.94	29.0	1.14	10.9	0.43	9.7	0.38	63.2	2.49	63.2	2.49	38.4	1.51	49.0	1.93	55.9	2.20
1-1/4	64.3	2.53	24.6	0.97	29.5	1.16	12.4	0.49	11.2	0.44	67.1	2.64	64.0	2.52	46.0	1.81	57.2	2.25	60.2	2.37
1-1/2	67.8	2.67	25.4	1.00	29.5	1.16	12.4	0.49	12.7	0.50	71.4	2.81	65.0	2.56	49.3	1.94	71.4	2.81	65.0	2.56
2	84.1	3.31	26.2	1.03	30.0	1.18	15.5	0.61	15.7	0.62	75.2	2.96	68.1	2.68	52.3	2.06	72.9	2.87	69.1	2.72

[a] For dimensions shown in Figure 49A but not specified in Table 21, see corresponding dimensions for respective straight thread size in Figure 3B and Table 4.
For dimensions of mating bosses, see Figure 1 and Table 1 of SAE J1926.
[b] For dimensions shown in Figure 49B and 49C, but not specified in Table 21, see corresponding dimensions for respective straight thread size in Figure 10A and Table 4.
[c] Minimum design thickness, not subject to inspection.
[d] American Standard Straight Pipe Thread for Mechanical Joints.
[e] Dryseal American Standard Taper Pipe Thread.
[f] For minimum bar stock size, see "C Hex," Table 21.

10. Section 6—Tables for Calculating Dimensions on Special Sizes. Tables 22 through 32 and Figure 50 are instructions which may be used for determining the overall lengths, leg lengths, and stock sizes applicable to special size combination fittings not covered in the standard dimensional tabulations.

10.1 Tables for Calculating Dimensions on Special Sizes. Tables 22 to 32 present various factors to be used in determining the dimensions applicable to special size combination fittings not contained in SAE J514.

In Tables 23, 27, 28, and 29, no factors are given for extreme combination sizes because of differences in factors due to method of manufacture. These extreme conditions are rare and it is suggested a manufacturer be contacted for the proper dimension.

No factors are given for bulkhead or swivel ends as combinations are not generally specified for these fittings.

Tables 30 to 32 present the minimum stock size acceptable for the various machine ends. Minimum stock sizes specified in Tables 31 and 32 do not apply to adapter unions, Figures 47A to 49C.

For any nonstandard size fitting, be it a connector, 45 or 90 degree elbow, tee, or cross, one end is always standard, conforming to the SAE J514 tables of dimensions. Considering this end to be the largest on the fitting, it may then be used as a basis for establishing the stocksize and length (either over-all or end to center) for all other parts by deducting factors equivalent to the reduction in machining requirements from the appropriate standard lengths as shown in Figures 51A and 51B.

The factors applicable to the various end configurations and size reductions tabulated in the tables were determined on the following basis:

Those pertaining to lengths were derived by maintaining the standard hexagon thickness for straight fittings and the standard centerline to machining start for shaped fittings.

The factors shown in Tables 22, 24, 26, 28, and 29 were derived by subtracting the standard machining length required for the smaller end from that required for the larger standard end and rounding the result to a two-place decimal.

The factors given in Tables 23, 25, and 27 were derived by subtracting the standard machining length plus an allowance of 1-1/2 pitches (threads) for imperfect thread length required for the smaller end from the same value required for the larger end and rounding the result to a two-place decimal.

The minimum allowable stock size for the various types of ends are also tabulated for reference purposes.

10.1.1 DRILL PASSAGES. At manufacturer's option, drill through passages in straight special size (jump) fittings may conform to the smaller diameter specified for up to two step size difference, or conform to one of the following for any size difference:

a. The appropriate end may be countersunk to the larger diameter, or
b. The appropriate end may be drilled to the larger diameter up to the middle of the hex.

10.2 Examples

10.2.1 For a 37 degree flared male connector (Figure 2A) with 1/2 tube OD and 3/4 NPTF, the overall length would be determined as follows:

2.06 = L overall length for 3/4 tube to 3/4 NPTF from Table 2
-0.21 = Factor from Table 22 for 1/2 machining on 3/4 size fitting
1.85 = Overall length for the nonstandard male connector

Since the 3/4 NPTF is the larger machining, the hexagon width of 1-1/8 from Table 31 would apply.

TABLE 22—FACTORS FOR 37 DEGREE FLARED END ON STRAIGHT FITTINGS (FIGURES 2A TO 2D, 3A TO 3C, AND 15)

		Standard Matching Size																								
	Nominal Tube OD	3/16 mm	3/16 in	1/4 mm	1/4 in	5/16 mm	5/16 in	3/8 mm	3/8 in	1/2 mm	1/2 in	5/8 mm	5/8 in	3/4 mm	3/4 in	7/8 mm	7/8 in	1 mm	1 in	1-1/4 mm	1-1/4 in	1-1/2 mm	1-1/2 in	2 mm	2 in	Nominal Tube OD
Reduced Maching Size	1/8	0.8	0.03	2.5	0.10	2.5	0.10	2.8	0.11	5.3	0.21	7.9	0.31	10.7	0.42	11.2	0.44	11.7	0.46	13.0	0.51	16.3	0.64	22.6	0.89	1/8
	3/16	—	—	1.8	0.07	1.8	0.07	2.0	0.08	4.6	0.18	7.1	0.28	9.9	0.39	10.4	0.41	10.9	0.43	12.2	0.48	15.2	0.60	21.6	0.85	3/16
	1/4	—	—	—	—	0.0	0.00	0.3	0.01	2.8	0.11	5.3	0.21	7.9	0.31	8.6	0.34	9.1	0.36	10.4	0.41	13.5	0.53	19.8	0.78	1/4
	5/16	—	—	—	—	—	—	0.3	0.01	2.8	0.11	5.3	0.21	7.9	0.31	8.6	0.34	9.1	0.36	10.4	0.41	13.5	0.53	19.8	0.78	5/16
	3/8	—	—	—	—	—	—	—	—	2.5	0.10	5.1	0.20	7.9	0.31	8.4	0.33	9.1	0.36	10.2	0.40	13.5	0.53	19.8	0.78	3/8
	1/2	—	—	—	—	—	—	—	—	—	—	2.5	0.10	5.3	0.21	5.8	0.23	6.4	0.25	7.6	0.30	10.9	0.43	17.3	0.68	1/2
	5/8	—	—	—	—	—	—	—	—	—	—	—	—	2.8	0.11	3.3	0.13	3.8	0.15	5.1	0.20	8.4	0.33	14.7	0.58	5/8
	3/4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.8	0.03	1.3	0.05	2.3	0.09	5.6	0.22	11.9	0.47	3/4
	7/8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.5	0.02	1.8	0.07	4.8	0.19	11.2	0.44	7/8
	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.3	0.05	4.3	0.17	10.7	0.42	1
	1-1/4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.3	0.13	9.7	0.38	1-1/4
	1-1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6.4	0.25	1-1/2

10.2.2 For a 37 degree flared 90 degree male elbow (Figure 4A) with 1/2 OD tube and 3/4 NPTF, the end to center length M would be derived as follows:

1.66 = M dimension for standard 3/4 37 degree end
-0.24 = Factor from Table 23 for 1/2 machining on 3/4 size fitting
1.42 = End to center length

Since the 3/4 NPTF is the standard end, the N end-to-center dimension would remain 1.59 as shown in Table 4. The wrench flat size would be as shown by the Y column in Table 4 for the 3/4 tube OD.

10.3 Tolerances. The following tolerances apply to nonstandard sizes:

Overall length of straight fittings = ±0.5 mm (±0.02 in)
Centerline to end on shaped fittings = ±1.5 mm (±0.06 in)

TABLE 23—FACTORS FOR 37 DEGREE FLARED END ON SHAPE FITTINGS (FIGURES 4A TO 4E, 5A TO 5D, 6A TO 6C, 7A TO 7D, 8C, 9A TO 9D, AND 10A TO 10C)

	Standard Matching Size																							
Reduced Maching Size	Nominal Tube OD	3/16 mm	3/16 in	1/4 mm	1/4 in	5/16 mm	5/16 in	3/8 mm	3/8 in	1/2 mm	1/2 in	5/8 mm	5/8 in	3/4 mm	3/4 in	7/8 mm	7/8 in	1 mm	1 in	1-1/4 mm	1-1/4 in	1-1/2 mm	1-1/2 in	2 mm	2 in	Nominal Tube OD
	1/8	0.8	0.03	2.8	0.11	2.8	0.11	3.3	0.13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1/8
	3/16	—	—	2.0	0.08	2.0	0.08	2.5	0.10	5.3	0.21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3/16
	1/4	—	—	—	—	0.0	0.00	0.3	0.01	3.3	0.13	6.1	0.24	—	—	—	—	—	—	—	—	—	—	—	—	1/4
	5/16	—	—	—	—	—	—	0.3	0.01	3.3	0.13	6.1	0.24	9.1	0.36	—	—	—	—	—	—	—	—	—	—	5/16
	3/8	—	—	—	—	—	—	—	—	2.8	0.11	5.8	0.23	8.9	0.35	9.7	0.38	—	—	—	—	—	—	—	—	3/8
	1/2	—	—	—	—	—	—	—	—	—	—	3.0	0.12	6.1	0.24	6.9	0.27	7.4	0.29	—	—	—	—	—	—	1/2
	5/8	—	—	—	—	—	—	—	—	—	—	—	—	3.0	0.12	3.8	0.15	4.3	0.17	5.6	0.22	—	—	—	—	5/8
	3/4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.8	0.03	1.3	0.05	2.3	0.09	5.5	0.22	—	—	3/4
	7/8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.5	0.02	1.8	0.07	4.8	0.19	11.2	0.44	7/8
	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.3	0.05	4.3	0.17	10.7	0.42	1
	1-1/4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.3	0.13	9.7	0.38	1-1/4
	1-1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6.4	0.25	1-1/2

TABLE 24—FACTORS FOR FLARELESS STRAIGHT FITTINGS (FIGURES 19A TO 19D, 20A TO 20C, AND 30)

	Standard Machining Size														
Reduced Maching Size	Nominal Tube OD	3/16 mm	3/16 in	1/4 mm	1/4 in	5/16 mm	5/16 in	3/8 mm	3/8 in	1/2 mm	1/2 in	5/8 mm	5/8 in	3/4 thru 2 mm	3/4 thru 2 in
	1/8	1.3	0.05	2.0	0.08	2.0	0.08	2.5	0.10	4.8	0.19	6.4	0.25	7.9	0.31
	3/16	—	—	0.8	0.03	0.8	0.03	1.3	0.05	3.6	0.14	5.1	0.20	6.6	0.26
	1/4	—	—	—	—	0.0	0.00	0.5	0.02	2.8	0.11	4.3	0.17	5.8	0.23
	5/16	—	—	—	—	—	—	0.5	0.02	2.8	0.11	4.3	0.17	5.8	0.23
	3/8	—	—	—	—	—	—	—	—	2.3	0.09	3.8	0.15	5.3	0.21
	1/2	—	—	—	—	—	—	—	—	—	—	1.5	0.06	3.0	0.12
	5/8	—	—	—	—	—	—	—	—	—	—	—	—	1.5	0.06
	3/4 to 1-1/2	—	—	—	—	—	—	—	—	—	—	—	—	0.0	0.00

TABLE 25—FACTORS FOR FLARELESS SHAPE FITTINGS (FIGURES 21A TO 21E, 22A TO 22D, 23A TO 23C, 24A TO 24D, 25C, 26A TO 26D, AND 27A TO 27C)

	Standard Machining Size														
Reduced Maching Size	Nominal Tube OD	3/16 mm	3/16 in	1/4 mm	1/4 in	5/16 mm	5/16 in	3/8 mm	3/8 in	1/2 mm	1/2 in	5/8 mm	5/8 in	3/4 thru 2 mm	3/4 thru 2 in
	1/8	1.3	0.05	2.5	0.10	2.5	0.10	3.0	0.12	5.8	0.23	7.6	0.30	9.7	0.38
	3/16	—	—	1.3	0.05	1.3	0.05	1.8	0.07	4.6	0.18	6.4	0.25	8.4	0.33
	1/4	—	—	—	—	0.0	0.00	0.5	0.02	3.3	0.13	5.1	0.20	7.1	0.28
	5/16	—	—	—	—	—	—	0.5	0.02	3.3	0.13	5.1	0.20	7.1	0.28
	3/8	—	—	—	—	—	—	—	—	2.8	0.11	4.6	0.18	6.6	0.26
	1/2	—	—	—	—	—	—	—	—	—	—	1.8	0.07	3.8	0.15
	5/8	—	—	—	—	—	—	—	—	—	—	—	—	2.0	0.08
	3/4 to 1-1/2	—	—	—	—	—	—	—	—	—	—	—	—	0.0	0.00

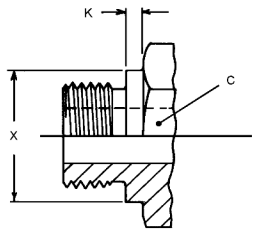


FIGURE 50—SMALLER NONADJUSTABLE STRAIGHT THREAD END

TABLE 26—FACTORS FOR NONADJUSTABLE STRAIGHT THREAD ENDS (FIGURES 3B, 3C, 20B, 20C)

		Standard Matching Size																					
	Nominal Tube OD	3/16 mm	3/16 in	1/4 mm	1/4 in	5/16 mm	5/16 in	3/8 mm	3/8 in	1/2 mm	1/2 in	5/8 mm	5/8 in	3/4 mm	3/4 in	7/8 mm	7/8 in	1 mm	1 in	1-1/4 mm	1-1/4 in	1-1/2 mm	1-1/2 in
Reduced Maching Size	1/8	0.0	0.00	–1.5	–0.06	+0.8	+0.03	0.0	0.00	–1.3	–0.05	–2.8	–0.11	–5.3	–0.21	–5.3	–0.21	–5.3	–0.21	–5.3	–0.21	–5.3	–0.21
	3/16	—	—	–1.5	–0.06	–1.5	–0.06	0.0	0.00	–1.3	–0.05	–2.8	–0.11	–5.3	–0.21	–5.3	–0.21	–5.3	–0.21	–5.3	–0.21	–5.3	–0.21
	1/4	—	—	—	—	0.0	0.00	–0.8	–0.03	+0.3	+0.01	–1.3	–0.05	–3.6	–0.14	–3.6	–0.14	–3.6	–0.14	–3.6	-0.14	–3.6	–0.14
	5/16	—	—	—	—	—	—	–0.8	–0.03	+0.3	+0.01	–1.3	–0.05	–3.6	–0.14	–3.6	–0.14	–3.6	–0.14	–3.6	-0.14	–3.6	–0.14
	3/8	—	—	—	—	—	—	—	—	–1.0	–0.04	+0.3	+0.01	–2.8	–0.11	–2.8	–0.11	–2.8	–0.11	–2.8	–0.11	–2.8	–0.11
	1/2	—	—	—	—	—	—	—	—	—	—	–1.5	–0.06	–0.8	–0.03	–0.8	–0.03	–0.8	–0.03	–0.8	–0.03	–0.8	–0.03
	5/8	—	—	—	—	—	—	—	—	—	—	—	—	–2.3	–0.09	+0.8	+0.03	+0.8	+0.03	+0.8	+0.03	+0.8	+0.03
	3/4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0	0.00	0.0	0.00	+3.3	+0.13	+3.3	+0.13
	7/8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0	0.00	+3.3	+0.13	+3.3	+0.13
	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+4.1	+0.16	+4.1	+0.16
	1-1/4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+4.1	+0.16
	1-1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Fittings involving hex sizes larger than "C" shall include a turned shoulder of diameter "X" and thickness "K" as shown in Figure 50. This turned shoulder permits the reduced straight thread end to seat in a standard port spotface.
For some combinations, additional length will be required to accommodate this feature. Therefore, all factors designated as plus in above table should be added to standard length dimensions to obtain applicable values.

	Nominal Tube OD	2 mm	2 in	Nominal Tube OD	X Dia mm ±0.3	X Dia in ±0.01	K mm ±0.5	K in ±0.02	C[a] Hex mm	C[a] Hex in
Reduced Maching Size	1/8	–5.3	–0.21	1/8	12.7	0.50	2.3	0.09	14.27	9/16
	3/16	–5.3	–0.21	3/16	14.2	0.56	2.3	0.09	15.88	5/8
	1/4	–3.6	–0.14	1/4	16.0	0.63	2.3	0.09	17.48	11/16
	5/16	–3.6	–0.14	5/16	17.5	0.69	2.3	0.09	19.05	3/4
	3/8	–2.8	–0.11	3/8	19.0	0.75	2.3	0.09	20.64	13/16
	1/2	–0.8	–0.03	1/2	23.9	0.94	3.3	0.13	25.40	1
	5/8	+0.8	+0.03	5/8	26.9	1.06	3.3	0.13	28.58	1-1/8
	3/4	+3.3	+0.13	3/4	33.3	1.31	3.3	0.13	31.92	1-3/8
	7/8	+3.3	+0.13	7/8	36.6	1.44	3.3	0.13	38.10	1-1/2
	1	+4.1	+0.16	1	39.6	1.56	4.1	0.16	41.28	1-5/8
	1-1/4	+4.1	+0.16	1-1/4	47.7	1.88	4.1	0.16	49.22	1-15/16
	1-1/2	+4.1	+0.16	1-1/2	54.1	2.13	4.1	0.16	55.58	2-3/16

TABLE 27—FACTORS FOR ADJUSTABLE STRAIGHT THREAD ENDS (FIGURES 9D, 10A TO 10C, 26D, AND 27A TO 27C)

		Standard Machining Size													
	Nominal Tube OD	3/16 mm	3/16 in	1/4 mm	1/4 in	5/16 mm	5/16 in	3/8 mm	3/8 in	1/2 mm	1/2 in	5/8 mm	5/8 in	3/4 thru 2 mm	3/4 thru 2 in
Reduced Maching Size	3/16	—	—	2.8	0.11	2.8	0.11	4.3	0.17	7.6	0.30	—	—	—	—
	1/4	—	—	—	—	0.0	0.00	1.5	0.06	4.8	0.19	8.9	0.35	—	—
	5/16	—	—	—	—	—	—	1.5	0.06	4.8	0.19	8.9	0.35	—	—
	3/8	—	—	—	—	—	—	—	—	3.3	0.13	7.4	0.29	11.4	0.45
	1/2	—	—	—	—	—	—	—	—	—	—	4.1	0.16	8.1	0.32
	5/8	—	—	—	—	—	—	—	—	—	—	—	—	4.1	0.16
	3/4 to 1-1/2	—	—	—	—	—	—	—	—	—	—	—	—	0.0	0.00

TABLE 28—FACTORS FOR ALL MALE PIPE ENDS (FIGURES 2A, 4A TO 4C, 4E, 5C, 5D, 19A, 21A TO 21C, 21E, 22C AND 22D)

		Standard Pipe Size															
	Nominal Pipe Size	1/4 mm	1/4 in	3/8 mm	3/8 in	1/2 mm	1/2 in	3/4 mm	3/4 in	1 mm	1 in	1-1/4 mm	1-1/4 in	1-1/2 mm	1-1/2 in	2 mm	2 in
Reduced Pipe Size	1/8	4.8	0.19	4.8	0.19	9.7	0.38	9.7	0.38	—	—	—	—	—	—	—	—
	1/4	—	—	0.0	0.00	4.8	0.19	4.8	0.19	9.7	0.38	—	—	—	—	—	—
	3/8	—	—	—	—	4.8	0.19	4.8	0.19	9.7	0.38	10.4	0.41	—	—	—	—
	1/2	—	—	—	—	—	—	0.0	0.00	4.8	0.19	5.6	0.22	6.4	0.25	—	—
	3/4	—	—	—	—	—	—	—	—	4.8	0.19	5.6	0.22	6.4	0.25	7.1	0.28
	1	—	—	—	—	—	—	—	—	—	—	0.8	0.03	1.5	0.06	2.3	0.09
	1-1/4	—	—	—	—	—	—	—	—	—	—	—	—	0.8	0.03	1.5	0.06
	1-1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.8	0.03

TABLE 29—FACTORS FOR ALL FEMALE PIPE ENDS (FIGURES 2D, 5A, 6A, 6B, 19D, 22A, 23A, AND 23B)

		Standard Pipe Size															
	Nominal Pipe Size	1/4 mm	1/4 in	3/8 mm	3/8 in	1/2 mm	1/2 in	3/4 mm	3/4 in	1 mm	1 in	1-1/4 mm	1-1/4 in	1-1/2 mm	1-1/2 in	2 mm	2 in
Reduced Pipe Size	1/8	5.3	0.21	5.6	0.22	11.2	0.44	11.4	0.45	—	—	—	—	—	—	—	—
	1/4	—	—	0.3	0.01	5.8	0.23	6.1	0.24	11.9	0.47	—	—	—	—	—	—
	3/8	—	—	—	—	5.6	0.22	5.8	0.23	11.7	0.46	12.2	0.48	—	—	—	—
	1/2	—	—	—	—	—	—	0.3	0.01	6.1	0.24	6.6	0.26	6.6	0.26	—	—
	3/4	—	—	—	—	—	—	—	—	5.8	0.23	6.4	0.25	6.4	0.25	6.9	0.27
	1	—	—	—	—	—	—	—	—	—	—	0.5	0.02	0.5	0.02	1.0	0.04
	1-1/4	—	—	—	—	—	—	—	—	—	—	—	—	0.0	0.00	0.5	0.02
	1-1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.5	0.02

TABLE 30—MINIMUM STOCK SIZE FOR TUBE ENDS

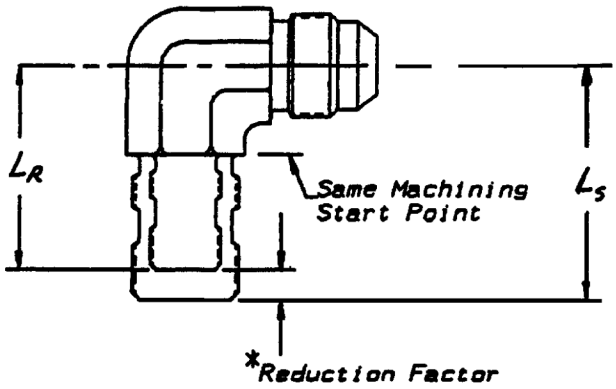
Nominal Tube OD	Hexagon Width Minimum	Width Over Forged Pads Minimum
1/8	3/8	0.31
3/16	7/16	0.38
1/4	1/2	0.44
5/16	9/16	0.50
3/8	5/8	0.56
1/2	13/16	0.75
5/8	15/16	0.88
3/4	1-1/8	1.06
7/8	1-1/4	1.19
1	1-3/8	1.31
1-1/4	1-11/16	1.62
1-1/2	2	1.88
2	2-5/8	2.50

TABLE 31—MINIMUM STOCK SIZE FOR FEMALE PIPE ENDS (EXCEPT ADAPTER UNIONS, FIGURES 48A TO 48C

Nominal Pipe Size	Hexagon Width Minimum	Width Over Forged Pads Minimum
1/8	9/16	0.56
1/4	3/4	0.75
3/8	7/8	0.88
1/2	1-1/8	1.06
3/4	1-3/8	1.31
1	1-5/8	1.62
1-1/4	2	1.88
1-1/2	2-3/8	2.50
2	2-7/8	2.81

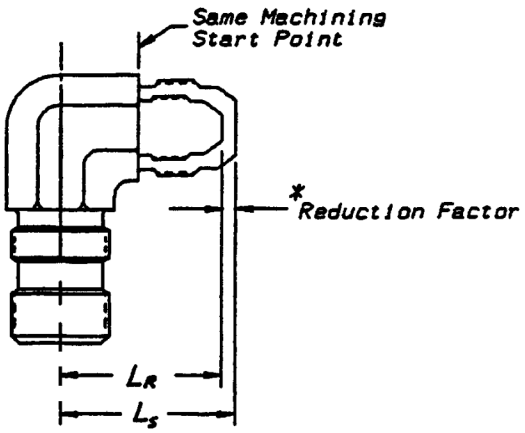
TABLE 32—MINIMUM STOCK SIZE FOR MALE PIPE ENDS (EXCEPT ADAPTER UNIONS, FIGURES 47A TO 47C)

Nominal Pipe Size	Hexagon Width Minimum	Width Over Forged Pads Minimum
1/8	7/16	0.44
1/4	9/16	0.56
3/8	3/4	0.75
1/2	7/8	0.88
3/4	1-1/8	1.06
1	1-3/8	1.31
1-1/4	1-11/16	1.62
1-1/2	2	1.88
2	2-1/2	2.50



L_S - Standard Size
$L_R = (L_S$ -Reduction Factor)

FIGURE 51A—JUMP SIZE CALCULATIONS—PORT SIZE



L_S - Standard Size
$L_R = (L_S$ -Reduction Factor)

*Reduction Factor Equals:

(MIN. PERF. THRD. Length + 1 1/2 Pitches of Standard Size.) — (MIN. PERF. THRD. Length + 1 1/2 Pitches of Smaller Size.)

FIGURE 51B—JUMP SIZE CALCULATIONS—TUBE SIDE

11. Notes

11.1 Marginal Indicia. The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE FLUID CONDUCTORS AND CONNECTORS TECHNICAL COMMITTEE SC1—AUTOMOTIVE AND HYDRAULIC TUBE AND FITTINGS

APPENDIX A

OPTIONAL METRIC FITTING FLAT DIMENSIONS.

By agreement between user and supplier, the metric flat sizes in Table A1, shall be used in lieu of inch sizes.

TABLE A1—OPTIONAL METRIC FITTING FLAT DIMENSIONS

Size	Y Forging	Y Barstock Max	Y_1 Forging
–3	12.00/–0.8		14.00/–0.8
–4	12.00/–0.8	14	14.00/–0.8
–5	14.00/–0.8	17	14.00/–0.8
–6	14.00/–0.8	22	19.00/–0.8
–8	19.00/–0.8	22	22.00/–0.8
–10	22.00/–0.8	32	27.00/–1.0
–12	27.00/–1.0	36	32.00/–1.0
–14	32.00/–1.0	41	32.00/–1.0
–16	32.00/–1.0	41	41.00/–1.0
–20	41.00/–1.0	55	50.00/–1.0
–24	50.00/–1.0	60	65.00/–1.0
–32	65.00/–1.0	80	70.00/–1.0

APPENDIX B

TEST DATA SHEET FOR HYDRAULIC TUBE FITTINGS

Manufacturer _____ Part No. _____ SAE Fitting Code _____

Fitting Size _____ Type f Construction (Per 3.9) _____

Fitting Type _____ Minimum Material Tensile Strength _____ MPa (psi)

Working Pressure Rating (Per Table 1) MPa (psi) Oil Temperature ____°C (°F)

Test Pressure (= 133% W.P.) ____ MPa (psi) Impulse Cycle Rate (Per 4.4 ____ cpm)

Impulse Cycle Goal for Fitting 1 000 000 Cycles (Per 4.4)

Minimum Burst Pressure (= 4 x W.P. ____ MPa (psi) - Per 4.3 - See Table ____)

Proof Test all Samples (= 2 x W.P. ____ MPa (psi) - Per 4.2 - See Table ____)

Qualification Test Assembly Torque ____ Nm (lb-ft) - Per Table ____

Minimum No. of Test Samples

6 Samples impulse tested
3 Samples burst tested
3 Samples over torque tested
3 Samples repeated assembly tested

* Note: Nuts and components that require a braze cycle for manufacture must have been processed through that cycle or comparable annealing process and plated before test.

I. Impulse Test Results: (Per 4.4)

	Sample No.	Cycles @ Failure	Type of Failure
1.			
2.			
3.			
4.			
5.			
6.			

II Burst Test Results: Per 4.3 - see Table ___)

	Sample No.	*Nut Hardness	Pressure @ Failure	Type of Failure
1.		____ RB/RC	____ MPa (psi)	
2.		____ RB/RC	____ MPa (psi)	
3.		____ RB/RC	____ MPa (psi)	

III. Over Torque Test Results: (Per 4.7 - see Table ___)

	Nut No.	*Nut Hardness	Pressure @ Failure	Type of Failure
1.		____ RB/RC	____ Nm (lb-ft)	
2.		____ RB/RC	____ Nm (lb-ft)	
3.		____ RB/RC	____ Nm (lb-ft)	

IV. Repeated Assembly Test Results: (Per 4.8)

	Sample No.	Type of Failure
1.		
2.		

V. Conclusions: _____

VI. Dimensions: List Any Exception _____

NOTE: The above test should be conducted on each of the following types and sizes of fittings to ensure overall performance of all configurations: Figure 12 (070110), Figure 10A (070220), Figure 3B (070120), Figure 8C (070221), and Figure 14 (070115) for Section 1 and applicable figures for other sections.

SAE J514 Revised SEP2004

Rationale. The corrections to this document include:

1. Tables 1B and 4: The use of single place rounded, soft conversions for the drill sizes in SAE J514 results in an unavoidable conflict for these drills within the SAE document itself. Stating these values as metric drill sizes provides two equally acceptable bore sizes, which can be produced using the current tooling. Adding the alternate metric drill sizes for the larger parts provides a migration path to the ISO sizes and permits manufacturers to produce components acceptable in both markets.

2. Figures 11, 13 and 31: Changed the thread lead c'sink angle.

3. Paragraph 7.1: Removed paragraph 7.1 dealing with hexagon modification of standard fittings with SAE straight-thread O-ring male ends for use with MS33649 port. Fitting manufacturers are not seeing any noticeable demand for these modified fittings, therefore, the paragraph has outlived its usefulness.

4. Table 19: Changed dimensions from 9.6 to 9.7 for the -2 size; and 23.8 to 23.9 for the -16 size.

5. Table 21: Changed dimension from 19.1 to 19.0 for the -8 and -12 sizes.

6. Figure 31 and Table 12: Made changes to the figure to make the nut more favorable to the cold forming process. Added columns to Table 12: G Min. mm, G Min. in, T_1 Min. mm, and T_1 Min. in.

7. Figure 3C title, Changed code from "070122" to "071720".

8. Figure 11 title, Changed title from "Style A Nut" to "Long Nut".

9. Figure 12 title, Changed title from "Style B Nut" to "Short Nut".

10. Figure 15 title, Changed title from "Reducing Adapter" to "Reducing Adapter Without Large Nut".

11. Figure 20C title, Changed code from "080122" to "081720".

12. Figure 27C title, Changed code from "08428" to "080428".

13. Figure 30 title, Changed title from "Reducer" to "Reducer Without Large End Nut and Ferrule".

14. Table 10 and Figure 28: Changed "C" dimensions for 7/8" from "26.42" to "27.00" and "1.040" to "1.063". The current diameter "C" (1.040 in) of Style A Ferrule for 7/8" tube creates a 0.000 min flat at the top of the back angle (40°) when the geometry is drawn at minimum material condition. A larger diameter would prevent the 0.010 min from being violated.

Relationship of SAE Standard to ISO Standard. Not applicable.

Application. This SAE Standard covers complete general and dimensional specifications for 37 degree flared and flareless types of hydraulic tube fittings and O-ring plugs. Also included are pipe fittings for use in conjunction with these tube fittings. These fittings are intended for general application in hydraulic systems on industrial equipment and commercial products.

Reference Section

SAE J343—Tests and Procedures for SAE 100R Series Hydraulic Hose and Hose Assemblies

SAE J405—Chemical Compositions of SAE Wrought Stainless Steels

SAE J476—Dryseal Pipe Threads

SAE J512—Automotive Tube Fittings

SAE J533—Flares for Tubing

SAE J1065—Pressure Ratings for Hydraulic Tubing and Fittings

ANSI B1.20.3—Dryseal Pipe Threads (Inch)

ASTM B 117—Method of Salt Spray (Fog) Testing

Developed by the SAE Fluid Conductors and Connectors Technical Committee SC1—Automotive and Hydraulic Tube and Fittings

Sponsored by the SAE Fluid Conductors and Connectors Technical Committee